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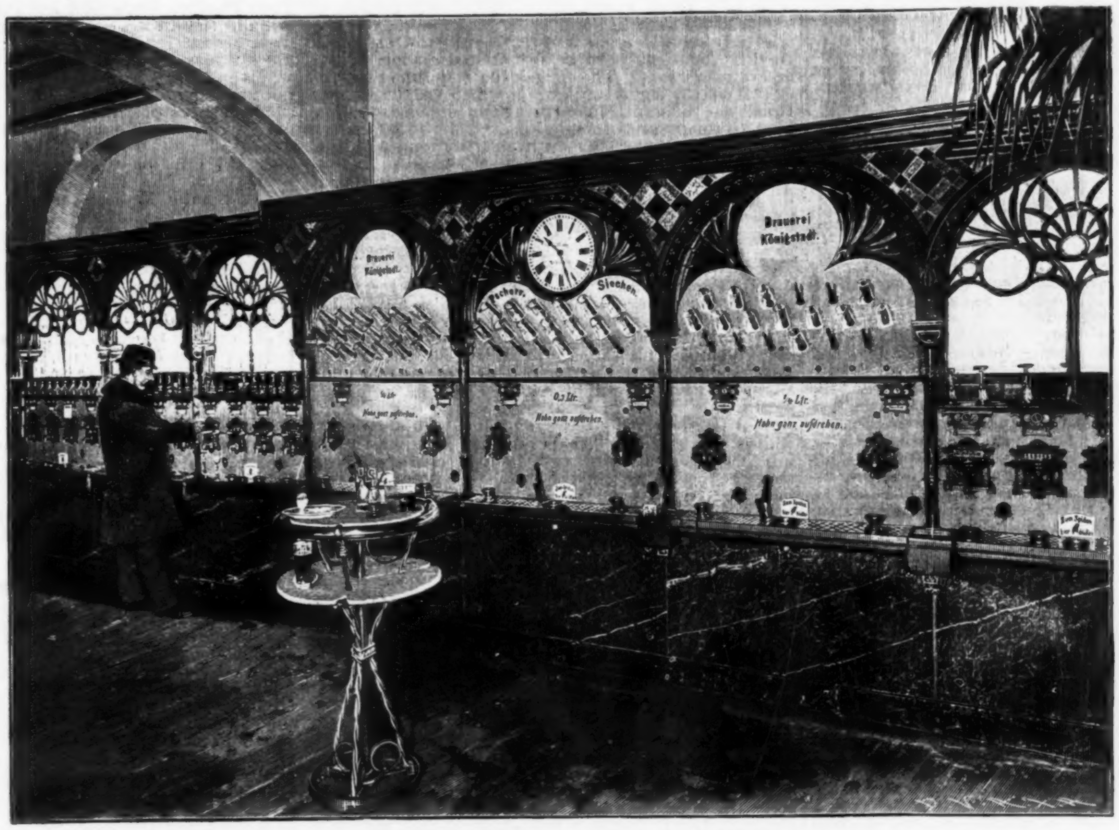
THE AUTOMATIC LUNCH COUNTER IN LEIPZIGERSTRASSE, BERLIN.

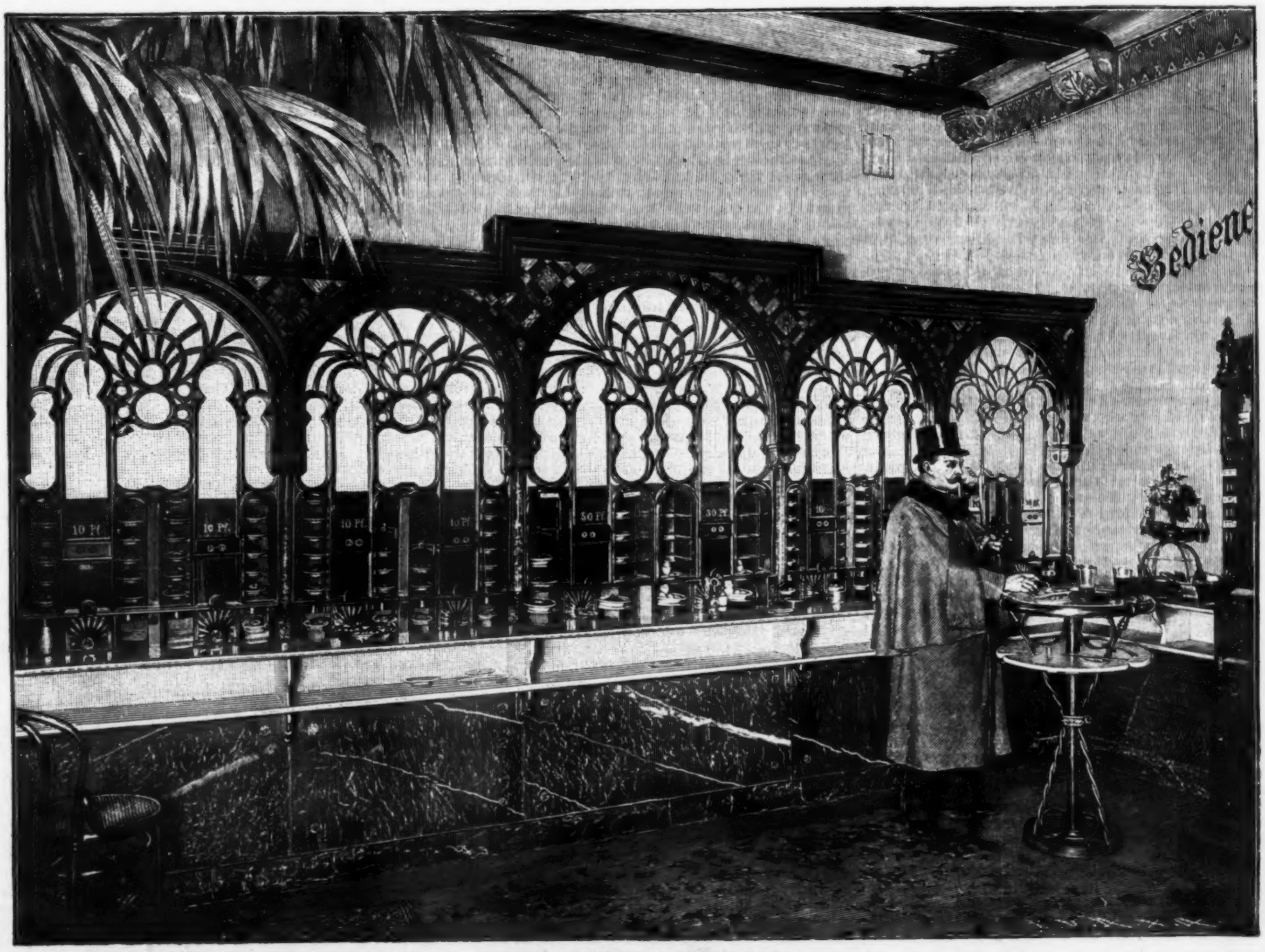
We had occasion to refer in the Scientific American for December 5, 1896, to a description of a restaurant in the Potsdamerstrasse, Berlin, Germany, where visitors are supplied with food by an automatic system.

The counters are built into the walls, and are surmounted by panels in which the automatic delivery arrangements are located. These are mainly of two kinds: Such as provide solid food and others from which drinks can be served. A person wishing to take lunch in the establishment follows the series of panels, each of which is labeled, and drops his coin into the proper slot by which a plate is lowered to the counter and another brought into position for the next customer. If the lunch is to be supplemented with a glass of any beverage, a glass is taken down from a peg, rinsed in a jet of water, and again a coin is dropped into the proper slot. Now the corresponding tap is placed automatically at the disposal of the purchaser, but, being regulated by clockwork, it measures out to him just one glassful. There are tables at which one can stand for the meal, or, if he prefers to sit down, he can have a chair and put his plate on the shelf of the table.

The prices are plainly marked for each variety of food, and range from ten pfennig to fifty pfennig, or about from two to twelve cents, which represents considerably more in Germany than in this country. The full plates are in view of the customers. All is kept very neat and cleanly, and the paneling is very tasteful and



AUTOMATIC SERVING OF LIQUID REFRESHMENTS.



AUTOMATIC SERVING OF SOLID FOOD.

THE AUTOMATIC LUNCH COUNTER IN BERLIN.

even artistic, and the whole locality is calculated to stimulate the appetite. On the wall we see in one of our illustrations the word "Bediene," which is the first word of the inscription "Bediene Dich Selbst" (help yourself), in imitation of the well known "γνῶθισεαυτόν."

No doubt this arrangement will be found quite satisfactory, as the automatic distribution of tickets at the railway stations of the German capital has been, for, on one hand, the purchasers are free and undisturbed in their selection, and, on the other hand, the management of such a restaurant is very simple, requiring very little personal work. Such work is restricted to the preparation of the meals, and the refilling of empty plates and tanks. For our engraving and the foregoing particulars we are indebted to Ueber Land und Meer.

OUR GREAT GRAIN CROP—FUTURE OF THE BUSINESS.*

THE MOVEMENT OF THE CEREAL FOODS IN THE WESTERN HEMISPHERE: THEIR PRODUCTION, TRANSPORTATION, DUTIES AND CONSUMPTION.

By Dr. WILLIAM P. WILSON, Director of the Philadelphia Commercial Museums.

IN an assembly of millers at this time the unusual conditions of the grain and flour market in the immediate present are likely to be of more interest and attract more attention than the possibilities of future markets under normal conditions. As wise business men, it is well to forecast the future possibilities and, if in our power, to provide for a permanent outlet for our surplus flour, even when other wheat-producing nations have good harvests and are likely to export their usual quantities of wheat and flour.

The best authorities claim that the probable requirements of European importing countries for 1897 and 1898 will be 411,200,000 bushels, of which Great Britain will require 180,000,000. The actual exports during the year ending July 31, 1897, were 366,440,000 bushels, of which the United States and Canada exported 158,000,000; Russia, 112,000,000; Turkey and the Balkan States, 70,000,000; Argentine, 3,400,000; India, 1,040,000; Austria-Hungary, 22,000,000. After making all allowances, the United States and Canada will have to export 360,000,000 bushels of wheat to meet the demand of Europe, or 202,000,000 bushels annual amount larger than has been ever exported to Europe from these countries—in addition to what is needed for extra-European countries.

We congratulate the farmers and millers of the country on the prospects of the present year; but, realizing that other conditions may exist in another year, when Europe will not require so much from us, we feel it is the part of wisdom to look for other markets. In Europe we are liable to meet—as we have met—competition from other European countries and from Argentine, Australia, India and Egypt, which will cause the prices of flour and grain to fall below that which would return a fair reward for the labor employed in producing them. During the last twenty-five years the average annual exportation of wheat and flour has been 253,000,000 bushels from all exporting countries and 111,000,000 annual from the United States. During the last five years the average annual exportation from all countries has been 345,000,000 bushels, while that of the United States has been 164,000,000; so that, despite the fact that new wheat-producing countries like Argentine, Australia and Roumania have entered in the race, the United States still holds about the same percentage of the total amount exported. In Europe, the number of competitors is increasing to such an extent that if it were not for other markets, we should be in a sad plight before many years. In flour the United States has fallen off 2,000,000 barrels in amount exported, from the year ending June 30, 1893, when 16,620,339 barrels were exported, to the year ending June 30, 1897, when only 14,569,545 barrels were exported. During the year ending June 30, 1896, 14,000,211 barrels were exported—Great Britain taking 8,211,236 barrels; Brazil, 871,475; Hong-Kong, 826,000 barrels; Canada, 802,000 barrels. Europe, with all her millions of people outside of Great Britain, took less than 1,000,000 barrels, while the countries south of us took 3,000,000 barrels—almost as much as all the rest of the world combined outside of Great Britain. Asia, which has not been considered, until of late, as a market for flour, takes over a million barrels.

The market to which Americans will have to take their surplus flour is the country south of us (the Atlantic countries), South Africa, and the Asiatic countries. European countries are more likely to import our wheat and make their own flour; while the other countries are more than likely to continue to do as they are now doing—import more flour than wheat. Of the 21,000,000 cwt. of flour imported by Great Britain, 15,000,000 cwt. came from the United States; 1,932,100 cwt. from British North America; 1,692,000 from France; 1,398,000 from Austria, and 204,790 cwt. from Germany. In Europe we not only have to meet the competition of the other wheat-producing countries, but nations like France will import wheat and turn it into flour and compete with our millers in the British market. In the new market of South Africa we have made rapid strides. In 1895 the whole of South Africa imported only $111,750 worth of flour. In 1896 they imported $945,000, almost a million dollars. From the United States in the month of March, 1897, the importation was 300 per cent. greater than the corresponding period of 1896; that is, for the month of March, 1897, 300 per cent. greater than in the same month of 1896, showing the rapid growth of the export of flour to that country. The statistics of Cape Colony show that in 1896, of 13,896,392 lb. of wheat flour imported, over thirteen million came from the United States—seven million from the Pacific and six millions from the Atlantic coast of the United States. The tariff on this flour was $1.22 per cwt. The remarkable increase of exports to Asiatic ports in the last decade from 409,147 barrels in 1887 to 943,073 barrels in 1896 shows a gain of over 100 per cent.; and for nine months ending March 31, 1897, 882,204 barrels, which reached a million barrels before June 30, 1897. The shipments in this direction were mainly flour, and therefore of more interest to a miller. In Japan it appears that the capacity of that country for wheat production has not increased as rapidly as the population; and, therefore, the need of importation. Japan with her 42,000,000 and China with her 400,000,000 inhabitants—once the habit of using flour becomes general—will become a market capable of taking any surplus that we have. In China and Japan wheat is admitted free; while in most European countries flour is discriminated against by levying a higher duty on flour than wheat. This trade will not be held by the Pacific millers alone. Of the 30,000,000 cwt. flour imported by Great Britain from the United States, 20,000,000 comes from the Atlantic and 10,000,000 from the Pacific coast, that is, that goes to Great Britain. The extraordinary increase in the last few years of exportation of flour to Asia gives a reason to look for the continuation of the same increase in the future; and in this market European nations are not likely to compete.

In South America, Argentine, Chile and Uruguay are exporters of wheat, and Argentine and Chile exporters of flour. Chile exported, in 1885, 40,621 barrels, of which 16,360 went to Peru, 19,720 to Ecuador, 460 barrels only to Colombia and 77 barrels to Guatemala, leaving about 4,0000 to be distributed among Bolivia and other nations. The Argentine Republic exported in 1895 606,000 barrels of flour, of which 535,000 went to Brazil, the remaining 70,000 being scattered among England, Germany and other nations. Of the 301,000 barrels exported in the first six months of 1897 from the Argentine Republic, 299,000 went to Brazil—almost all of it. Very little Argentine flour goes to Europe, owing to the danger to the condition of the flour in crossing the tropics, which is not a matter to be disregarded.

The countries south of us, that are possible markets, have a population of 33,000,000 inhabitants, including Mexico, Central and the South American countries; and some of them are now importers of flour. At present Brazil takes 871,473 barrels; British West Indies, 572,842 barrels; Central America, 250,000 barrels; Venezuela, 218,000; Hayti, 197,000; Cuba, 176,000; British Guiana, 167,000; Colombia, 133,406; Porto Rico, 129,021; French West Indies, 109,118; and in other countries in smaller amounts, giving a total of 3,000,000 barrels, a market second only to that of Great Britain, and one in which Argentine alone is a large competitor, the amount of Chile's export being small, and her location excluding her from a large part of this territory. With these countries we should endeavor not only to hold, but also to increase our trade. Reciprocity in the past has done something to increase this trade, the effect of it in Brazil and Cuba being quite marked, as well as in Germany and France.

During the time when we had reciprocity with Brazil we had the following conditions: Brazil placed wheat, corn, seeds, flour, oil, coal, machinery and tools on the free list, and reduced the tariff on a number of other articles 25 per cent. in order to avoid a tax on coffee and secure admission free for her sugar. The effect on flour can be seen from the following: Two years before reciprocity came into effect, in 1890 (first year), we sent 687,342 barrels to Brazil; in 1891 we sent 722,369. Those are the two years preceding reciprocity. The first year of reciprocity we increased from 700,000 to over 900,000 barrels; and the next year (1893) we dropped off a trifle to 837,000; in 1894 we went up to 920,896 barrels. After that reciprocity was dropped. We dropped immediately the next year to something like 700,000 barrels. Flour during reciprocity was admitted free, now it is taxed at 57½c. a barrel. That is extremely low. In Cuba the effect on flour was as follows: Before reciprocity 114,000 barrels (the last year before introduced into Cuba); the next year it went up to a trifle over 300,000 barrels; the next year (1893) to over 600,000; the next year (1894) to 662,000; and the very first year that reciprocity was dropped it went down to 255,000. For Cuba, prior to reciprocity the tariff was $5 55 per barrel on flour. It was reduced to 88c. during reciprocity, and increased to $3.66 after. In Cuba free sugar was gained by the reduction on American products; in Brazil, free coffee and other things. Our great drawback is the high tariff imposed upon flour in most of these countries, largely for revenue purposes, but also, in some countries, to protect the home market. Reciprocity, therefore, might improve some of this; and, if it can be done, perhaps the 200,000,000 barrels of flour which we have dropped recently in our exportation since 1893 would be brought back again by reciprocity. If it could be so, it would be an object well worthy of the most arduous efforts of this association. If without reciprocity we are able to sell Brazil more than Argentine, her next neighbor, sells, how much more we would be likely to sell with reciprocity no one can say.

As Argentine is our greatest competitor, would it not be well to look more closely into her capabilities? The area of Argentine which is suitable for cultivation of wheat is 240,000,000 acres. Argentine takes in the whole of the southern part of South America; now includes Patagonia and runs up well north into the middle part of Brazil, the upper part being tropical; the whole middle part being temperate, and when you get down as low as Buenos Ayres, you have a climate not as cold as here—having frost and a little snow in winter, sometimes, but a very mild climate; and the whole of the region for many hundreds of miles north of Buenos Ayres and a great distance south is a wheat growing region, with very rich lands. Of the 240,000,000 acres in Argentine suitable for wheat growing, there are at the present time only a little over 7,000,000 acres cultivated for wheat.

In 1894, Argentine's best year (grasshoppers have eaten the wheat up, mostly, during the last year), Argentine exported 59,000,000 bushels of wheat and 459,527 barrels of flour. In 1895 it dropped off to 37,000,000 with, however, a little more flour (607,000 barrels of flour—the mills were increasing); in 1896 the exports dropped to 21,000,000 bushels of wheat (remember, in 1894 it had been 59,000,000), and the exportation of flour dropped down to 472,000 barrels; in 1897—a very bad year for the Argentine—the exportation of wheat was only 3,000,000 bushels and the flour 301,000 barrels. Twenty years ago, however, Argentine imported wheat and flour for her own consumption. Now it is the third wheat exporting nation; and although, at present, it is not a very important factor in the market, it will no doubt, in future, be a very large exporter of wheat and flour. In the Argentine Republic the cost of the production of wheat is estimated at 33 cents a bushel, not including cost of the land.

The average freight to Europe is only 15 cents a bushel; the nearness of the railroad stations to the seaboard averages only a hundred miles, as against the 1,000 miles of American travel. This is an important factor in favor of Argentine. There are in the Argentine Republic at the present time 416 flouring mills, of which 276 have modern machinery and are capable of producing 14,806,000 barrels of flour; but the actual output for consumption and export does not amount to more than 30 per cent. of this. In addition to the 276 mills are 18 second class and 122 third class mills. A factor in the price of wheat, and also of flour, is the low cost of living; the small farmers (who are principally Italians) live on a scale that the Americans could not endure; and with large families, all of them—from grandmother to children of tender years—joining in the work, they are able to put wheat on the market at a less rate than the American. If it were not for the poor facilities of handling the wheat from the farm to the railroad, they could produce it cheaper. They have no barns and are compelled to hurry the grain to the station as soon as it is harvested. Here there are rarely any warehouses; and the crop suffers much injury before it reaches the seaboard. At the wheat moving season in the Argentine Republic it is not uncommon to see, stacked up, hundreds of thousands of sacks of wheat at the stations without any covering. The different kinds of wheat grown in the Argentine may be of interest. Barletta, a hard red wheat, is principally grown in Santa Fe; the wheat from Antre Rios is somewhat superior; the wheat grown by the Russian farmers near Dramenti has a high reputation. Barletta varies in color, size and plumpness, sometimes looking like the original barletta seed that came from Italy, but always containing a considerable amount of gluten. The Tussala wheat is smaller, gray-back, with less strength but better color; and is sometimes not easy to distinguish it from the inferior Russian, Bulgarian or Lombardy wheats. French wheat is grown considerably in Buenos Ayres because it gives a very large yield; but it is more tender than barletta. It is short on gluten. The Bahia blanca wheat is the nearest like the American red wheat.

The Uruguayan wheat is not as good as the Argentine wheat, being deficient in strength. There is a great irregularity in the River Platte wheat, which is also augmented by the bad handling afterward.

In order to develop trade with southern countries on this continent, it will be well for millers to familiarize themselves with facts concerning the existing trade of these countries. The statistics of the United States show that no flour was exported to Argentine, Uruguay, or Paraguay, and to Chile and Bolivia practically none—the amount was so small; all of these but Bolivia and Paraguay being wheat exporting countries and supplying their own wants, and these two being largely supplied from their neighboring countries. Peru takes only 6,000 barrels and Ecuador 20,000—their wants being practically supplied by Chile. These two countries might be reached from the Pacific coast, but not from the Atlantic. The 3,000,000 barrels were mainly sold to Brazil, West Indies, South American countries on the Caribbean Sea and Central America.

Brazil, with her 14,000,000 population and the next largest customer for flour after Great Britain, has four flour mills only, for which wheat is largely imported from the River Platte—17,000,000 bushels having been imported in 1894. These mills are graded: First, the English flour mill—the Rio de Janeiro—50 sack plant (meaning 280 bushels to a sack); one fluminenci of Rio de Janeiro—30 sack plant; another of the four mills only a 5 sack plant, and another only three; that comprises the local mills of Brazil. The market in Brazil can be, contrary to general opinion, reached by a number of lines. There are regular steam lines from New York—among them, that of Slohmann & Prinz; and in addition to these there are a number of packet lines whose rates would be considerably lower for Rio and other ports. For more northern ports there is the Red Cross Line and one or two others; and sailing vessels could also be used. In the northern ports there are practically no competitors; and the only problem is to get sufficiently low rates to enable the flour to be sold at a price to find purchasers. In Rio, Argentine enters into competition; but as American flour is preferred, and sells, too, at a higher rate, there is no doubt, if trade were pushed and rates could be made low, it would enable the American flour to drive the ordinary flour out of the market; and especially if, under reciprocity, American flour was admitted free, instead of paying 57½c. duty, the Brazilian trade would take a million barrels instead of 75,000, as in 1896—if the millers would take the matter in hand and do the business promptly. The brands most quoted in these markets are Richmond 1 and 2 and Baltimore 1 and 2, and always at a higher price than the Argentine and Brazilian. Brazilian importers of flour claim that the market could be greatly enlarged if rates could be made lower, which could be done if sailing vessel rates could be obtained.

Cuba imported 664,000 barrels in 1893 under reciprocity and fell off 379,000 after reciprocity, taking in 1897 only 176,000 barrels, owing to conditions caused by the war. Cuba, under normal conditions and under reciprocity, could be counted on for 500,000 more barrels than last year. That would make 600,000 or 700,000, or one-fourth of the whole deficiency which we are now laboring under.

Mexico exported 645 bushels of wheat and 3 barrels of flour and imported 50,000 bushels of wheat and 46,819 barrels of flour. Although it has 12,000,000 population, it imports very little flour. First, because it is, contrary to general belief, a wheat-producing country and it is able to supply its own wants to a large extent; and, secondly, because of the high tariff, $4.50 a barrel, with 7 per cent. stamp duty added.

Now, a word about Venezuela. Venezuela imports 218,224 barrels, which amount would be much larger if it were not for the high duty, the duty on flour, including the internal revenue, amounting to 2⅓ cents per pound. Practically all the flour used in this country is imported from the United States, a very small amount also from Austria. The consumption is not great, as it is only used by the wealthy people. The grade used by the ordinary people throughout Venezuela is made from corn prepared at mills located in the various cities. The corn raised in the country is entirely raised for home consumption, and to protect this the present duty is established. Venezuela has declined to reduce the

* An address before the Pennsylvania State Millers' Association.

duty on flour, claiming that if the flour is imported it will come into general use and destroy the market that now exists for their own production of corn.

Guiana, Central America and the West Indies are so situated with reference to the United States as to make it possible for our millers to undersell all their competitors. If it were not for the high tariffs in all these countries, a much larger amount would be consumed. In the countries south of us, whose products are largely consumed by the United States, reciprocal arrangements would be desirable and beneficial to both parties. The possible increase of trade in these countries would probably give over 1,000,000 barrels out of the 2,000,000 we have fallen off, and the new markets in Asia and Africa would make another million. Familiarity with the tariffs, freight, customs and languages of these countries would greatly facilitate this trade.

To aid in bringing about this result, the Philadelphia museums have been established. In order to build up trade with foreign countries, it is necessary to go to work in a practical way. Certain points must always be considered—use, demand; the demand and the supply; by whom and with what particular duties; the prices at which (with the duties added) goods are bought and sold; the freight and duty to which they are subject; and, lastly, the houses that handle them. The general reputation of theses houses must be examined and every item connected with the shipment of goods and collections of payments must receive consideration. All this and much more is done by the Philadelphia Commercial Museums.

[Continued from SUPPLEMENT, No. 1131, page 18084.]

THE SCIENCE OF HUMANITY.*

By W. J. McGEE.

5. THE most elusive attributes of humanity are those manifested in conduct and feeling and thought; yet, paradoxically, it was these obscure products of intellectual activity that men first sought to guide and control, for in every generation in each stage of culture, from the lowest savagery to the highest enlightenment, parents have essayed to train their children, while first the tribal leaders and later the sages and statesmen have, semi-consciously or in full consciousness, striven ceaselessly to shape the mind of the masses. So education, or the voluntary control of individual mentality for the common good, has affected profoundly the entire course of human development and has served ever to widen the chasm separating man from the beasts. In the earlier stages of culture, as indicated by the customs of savages still living, education was limited to the lowly æsthetic and industrial activity of the prime; for the primitive thinker ascribes motive, complex feeling, and all but the simplest actions to ill conceived extraneous potencies against which it were bootless to strive. In higher savagery and in barbarism, the sphere of education extended to those features of conduct involved in the maintenance of tribal relations, and was effected partly by means of habitual appeal to the extraneous potencies, which were gradually crystallized in mythic systems themselves arising in a certain order determined partly by educational practice; for in much of savagery and in all of barbarism the sources of sentiment and motive are sought outside the individual and largely beyond the realm of the real. With the birth of civilization, education extended to feeling and thought, partly through appeal to ideal potencies, and there was a tendency to exalt the æsthetic and neglect the industrial; and certain educational systems rose so high into the supernal or passed so far into the metaphysical as to lose sight alike of individual conduct and of the sources of real knowledge. In modern enlightenment, especially in America, the methods and purposes of training are shaped by science, and, despite the struggle of the scholastics, education is becoming revolutionized. With the recognition of an actual universe knowable through sense and reason, training becomes definite in plan and useful in purpose; with the recognition of cerebral function and of the influence of exercise in developing the brain, the scientific psychologists of the present decade have gone far in erecting a new platform for pedagogy; and with the recognition of the relations among the activities and the activital products of man, the normal course of intellectual development would appear to have been made clear, for it seems manifest that just as observation begins with the simple and proceeds toward the complex, and just as activity begins with the spontaneous and passes into the volitional, so individual and collective mentality must arise in simple and perhaps spontaneous action, to grow through habit into sentiment, and to mature through unconscious or conscious thought in definite motive. It is heterodox, perhaps in more senses than one, to affirm that motive—the noblest character of humanity—buds in spontaneous action, blossoms in subconscious habit, and attains fruition in the highest intellectual activity, whether unconscious or conscious, of which the individual or group is capable; certainly the affirmation represents complete inversion of a notion dominant in savagery, prevalent in barbarism, and gradually weakening through civilization; yet it is sustained by all that is known of the processes of acquiring knowledge, by the history of the growth of knowledge in general, and, indeed, by nearly all applied statecraft and most applied priestcraft throughout human history. The recognition of the genesis and antecedents of motive must afford a vantage point for a clearer survey of the vast field of human emotion, affection, passion, aspiration, disposition; and, at the same time, it cannot fail to give a keynote for improved education, for the still more complete control of mind.

These are but a few of the many ways † in which the great science based on human activities tends to bring order out of that vast chaos of action and thought which has so long resisted analysis and synthesis—that last citadel of the unknown.

AND OF THE BASIS AND END OF THE SCIENCE OF HUMANITY.

Hitherto humanity has been the theme of poesy and romance rather than of sober science. All men have perceived that their kind possess attributes distinguishing them from the rocks and plants and beasts of lower nature, yet for the most part these attributes were either ignored or transfigured into a dazzling halo which defied analysis none the less by reason of its subjective character; even to-day and in the most enlightened circles of the most enlightened nations there are few willing to consider and content to consider dispassionately the purely human attributes; but to these few the chaos of industries and ideals, of emotions and passions, of conduct and motive, and of all other things human falls into a simple order nearly as definite as the order recognized in each of the older sciences—the order of human activities and activital products.

Exact knowledge began with the remote and progressed toward the near. With every stage of progress it has been a power for the conquest of natural forces and conditions, has exalted intellectual mankind above all brainless or small brained creatures, and has made continually for human welfare and happiness; and now that the methods and purposes of science are extending to the human body and brain it cannot be doubted that these, like all other material things, will be controlled and reconstructed for the good and the glory of intelligent man. This is the end of the science of humanity.

* Continuation of a paper read before the American Association for Advancement of Science, August, 1897.

† One of these is the control of society itself for the common good, as shown by Ward in his masterly memoir on "Dynamic Sociology," which it must suffice to mention merely.

THE BRITISH ASSOCIATION—ADDRESS IN MECHANICS.

THE address in Section G was delivered by Mr. G. F. Deacon, M.I.C.E., who referred to the great progress which has been made in mechanical science. After some introductory remarks, he said: It is not proposed to discuss the progress and prosperity which mechanical science has brought about in the Victorian era, much less that which the succeeding years will yield; but I venture to think that a proper subject for consideration from this chair, if not for discussion in this section, is to be found in any unnecessary waste of energy which may occur in the process of mental development of the men who are to succeed us in the great work to which we devote our lives. Having myself passed as an ordinary apprentice through workshops of mechanical engineering in the old days when working hours were longer than they are now—from six in the morning till six in the evening—and that, too, on the banks of the Clyde, where no special indulgence was given to what was sometimes called the "gentleman apprentice," and feeling convinced, as I still do, of the immense and permanent advantage derived from that experience, I shall not be judged to underrate its value in the case of others who have yet to choose the details of the career by which they expect to gain a place in the profession or business of an engineer. On the other hand, as a student thirty-four years ago under the late Prof. Macquorn Rankine and the present Lord Kelvin, I shall not be prone to underestimate the advantages of academical training in its proper application to the profession to which I am proud to belong.

TRAINING OF ENGINEERS.

Do not suppose that I think the training of the born engineer should not be controlled. He will stand head and shoulders above the rest of us whatever we may do with him; but in order that his exceptional parts may not wreck him as an engineer, and in order that his energies may be rightly directed at the start, he, too, should have the advantages of that systematic training which to his less gifted brethren is becoming more and more absolutely essential to success. At the time I began practice the large majority of young engineers were left entirely to their own devices so far as the attainment of any scientific knowledge was concerned. As pupils or apprentices, articled or not, they entered an engineer's works or office; for a certain number of years they had the run of the place and some encouragement if they worked well, but it could not in the nature of things, amount to much more. This was a very necessary, perhaps the most necessary, element of their training; but except to the few who were so constituted that with little or no guidance they could supplement their practical knowledge with the study of principles elsewhere, it was entirely ineffectual in the production of that well balanced attitude of mind which any person who properly assumes the name of an engineer must hold toward every engineering problem, great or small, which he is called upon to solve. And so strongly have I felt this, that in the earlier days, when there were fewer schools of practical science, and when their utility was little understood, I required, wherever the matter was under my control, the insertion into the articles of apprenticeship of a clause by which, at some inconvenience to the office, the pupil was required to attend two sessions at the science classes of Glasgow University, or at some other approved school of practical science; and without this condition I declined to take the responsibility attaching to the introduction into the profession of men who, in their earlier careers, from no fault of their own, had not even acquired a knowledge of what there was to learn, much less of how to learn it. More recently this course has become generally unnecessary, for in Westminster at least the young engineer rarely enters an office until he has acquired some knowledge of what he has to learn. He enters, in short, at a much more advanced age than formerly. When it is essential that he should be earning something soon after he comes of age, anything like a complete training is an impossibility; his work ceases to be general, and his practice is more or less confined in a much narrower sphere than need be the case if the pursuit of further knowledge continues to be his chief duty. It is not desirable, at least so it appears to me, that even at this stage his training should be specialized in view of the particular branch of the profession or business he is likely to follow. The fundamental principles of any branch of mechanical engineering are broadly the fundamental principles of any branch of the profession.

In America I understand that a college course of engineering generally includes workshop practice designed to supersede the old system of apprenticeship to a mechanical engineer. This fact and other important differences between the English and American practice have only lately come to my knowledge, and before they did so the substance of this address had been written. It might, in some particulars, require modification as applied to Canada, but it remains the result of my observations concerning the conditions of engineering education which obtain in the mother country. A few words now in relation to that physical and mental training gained laboriously, and somewhat wastefully as I think, at the joiner's bench, in the fitting and turning shops, the foundry and the forge, during the old course of mechanical engineering apprenticeship. I am convinced that the kind of knowledge which comes of thoughtful chipping and filing and turning and forging, though only applied to a few of the materials with which, in after life, the engineer has to deal, are quite as important as tables of density and strength to his future sense of rightness in constructive design. The use of such work is not merely to teach one the parts and combinations of any particular machine; in a still higher degree it is the insensible mastery of a much more subtle knowledge or mental power, the application of the senses of sight and touch and force, it may be of other senses also, to the determination of the nature of things.

The compulsory inclusion of the principles of all such subjects as chemistry, electricity, geology, and many others, in science courses intended for a future engineer is desirable, not only because a fundamental knowledge of them leaves open a very much wider field from which the engineer may, as opportunity offers, increase his knowledge and practice in the future, but because many of such subjects are inseparable from an intelligent understanding of almost any great engineering work. "Nothing so difficult as a beginning" may be a proverb of rather too far reaching a nature, but it contains the suggestion of a great truth, increasing in weight as we grow older, and the beginnings of such collateral sciences should therefore find a place in every engineering student's store of early knowledge.

AUTOMATIC EXTINCTION OF LAMPS.

AN ingenious arrangement of street lighting, which allows a reduction of the illumination at any time when less light is needed, is described in the Electrical Review. This arrangement is now in use in several places, but Portsmouth, England, is considered a notable instance, as the system has been successful there. It appears to be a system of automatic switches. "The automatic switch, which is being used on 240 lamp posts, is designed so that, when the arc lamps are turned off, the incandescent lamps are automatically lighted." It ought to be explained that each lamp pillar has an arc lamp as well as two incandescent lamps, the latter being employed during the period when the lesser illumination is desired. "The device consists of a coil in series with the arc light, and, when the arc lights are burning, the coil becomes energized and attracts the end of a lever; when, however, the arc lamps are extinguished, the rocking arm drops down upon a knife-edged switch, and this action has the effect of completing the incandescent circuit, thereby turning on the glow lamps." The paper quoted illustrates this arrangement by engravings which cannot here be reproduced.

The operation, however, is so simple that its general features may be understood without engravings. When the lever spoken of drops, the incandescent circuit is completed, the current passing through a tube straight to the lamps, returning to the switch through the arm of the lever and out again. This provides for the lighting of the glow lamps at the instant of extinguishing the arc light. The extinguishing of the incandescent lamps, in their turn, is accomplished by sending a reverse current through the arc lamps, and consequently through the coil, thus lifting the lever out of the switch and cutting out the incandescent lamps. To prevent the lever from falling back again into the switch, a permanent magnet is pivoted under the solenoid in such a manner that it may move horizontally. This magnet carries a catch, which, passing under the arm of the lever, holds it from falling back on to the switch when the current through the series coil is interrupted, while, at the same time, it permits the core of the solenoid to drop down to its original position. To insure that the lamps are all effectually cut out, the reverse current is turned on for about five minutes. When the current for the arc lights is sent through the lamps, the pivoted magnet which operates the catch is drawn back into its original position, which leaves the lever free to act, according as the coil is magnetized or demagnetized. The use of this apparatus in Portsmouth is estimated to have saved the wages of three men.

"**In view** of the continually increasing employment of iron in building construction," says the Revue Technique, "it is well not to lose sight of the disastrous action exerted by lime and plaster of Paris on this metal. If we plunge pieces of iron into a vessel of freshly prepared lime, a rapid oxidation takes place, especially if wrought iron or laminated iron is used. This oxidation is not confined to the surface, but rapidly reaches the heart of the iron, which in a very short time undergoes a profound alteration in resisting qualities. To this must be added the great expansion caused by increase of volume of the mass. It has been shown thus that iron frames put together solidly by means of clamps were nevertheless broken. The action of plaster of Paris is similar. On the other hand, cement seems to be an excellent preservative against rust, and it has been shown that pieces of iron covered with a thin layer of cement remained unaltered after being for a considerable time under water. It would even seem that such a covering is preferable to painting with red lead."

The perfect construction of a bicycle wheel so as to obtain an equal degree of tension upon each of the spokes is a matter of no little difficulty when it is computed that a single turn of the nut holding the end of a spoke in the rim may make a difference in the pull of some 50 lb. or 60 lb. and leave a very slight margin of safety, if any. From a highly interesting article on the subject contributed to our contemporary the Engineering News, we find that the results of tests proved a difference in the tension of high grade bicycle wheel spokes of as much as 100 per cent. between extremes. Presumably this great difference is the result of the employment of wood rims, which are almost universal in the United States, but it emphasizes very clearly the advantage derived from the use of the pneumatic tire in taking up shocks due to the unevenness of roads.

HEATING AND VENTILATION BY MOISTENED AIR IN SPINNING MILLS.

PORTER & LEWIS APPARATUS.—In this (Fig. 1) we find the funnels, set one into another, of the Roger Pye apparatus. Four apparatus of the same kind are usually arranged around the same center at which the steam pipe ends. This is clearly shown in Figs. 2 and

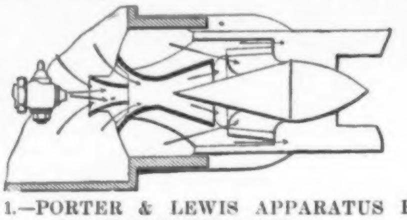


FIG. 1.—PORTER & LEWIS APPARATUS FOR MOISTENING AIR.

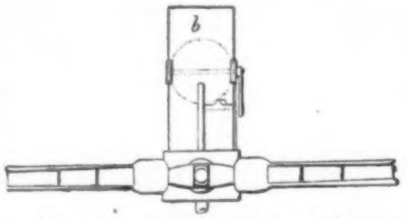


FIG. 2.—APPARATUS WITH FOUR ATOMIZERS.

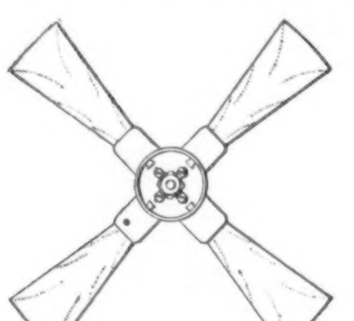


FIG. 3.

3, the former of which shows in addition the tube through which the cool air enters under the control of the register, b.

The Tattersall Apparatus.—The air under pressure is admitted through the large central conduit, a section of which is seen in Figs. 4 and 5, while the water circulates in the pipe situated immediately beneath the preceding. The two fluids make their exit through their respective ajutages, and the two jets, in crossing each other and in impinging against the screen placed opposite the air ajutage, become mixed. The air of the room, sucked by the gaseous current, becomes also mixed with them. The whole makes its exit through inclined nozzles. The water in excess is collected by the pipe situated at the lower part of the apparatus.

The Josephy Apparatus.—The water enters the revolving funnel, h (Fig. 6), and participates in its motion. The centrifugal speed which is thus given it projects it through a circular felt filter, b, into the drum, f. Here it meets with the current of air sucked in at o by the exhauster, d, which carries it along and causes it to make its exit from the apparatus in the direction shown by the arrows. But all that is carried along is the fine drops of water. The too large drops, which are thrown into the drum, f, impinge against its wall, and, along the latter, descend into the tank that is formed by the base of the drum, and that is connected with piping which leads the water in excess to the exterior. If the mist carried along by the current of ascending air contains dust, this is projected against

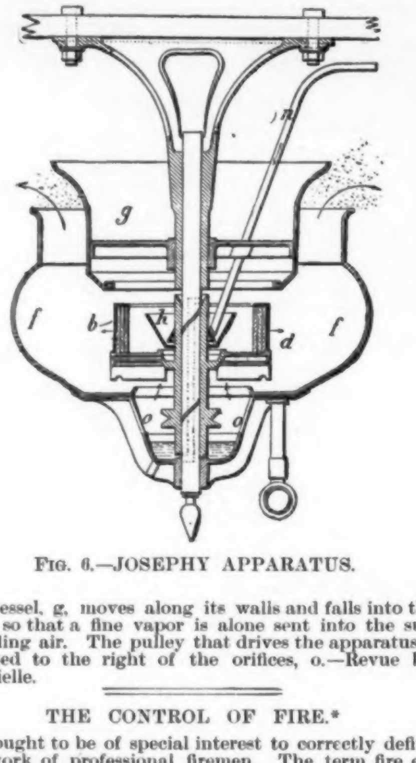


FIG. 6.—JOSEPHY APPARATUS.

the vessel, g, moves along its walls and falls into the tank, so that a fine vapor is alone sent into the surrounding air. The pulley that drives the apparatus is situated to the right of the orifices, o.—Revue Industrielle.

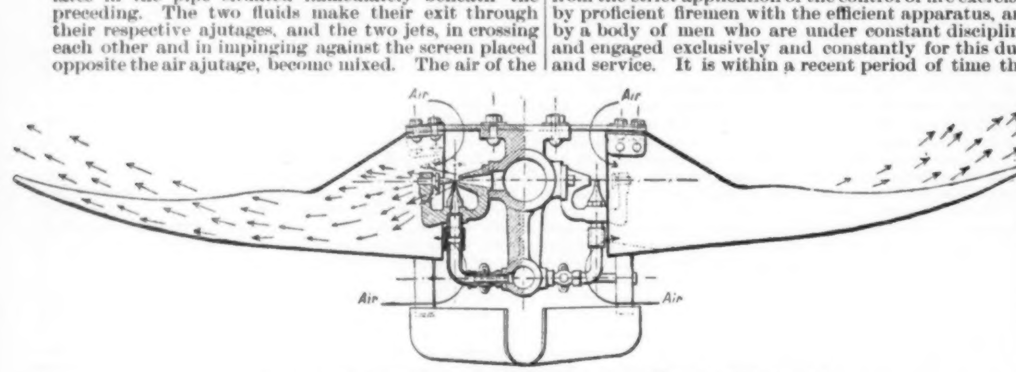


FIG. 4.—SECTION OF THE TATTERSALL APPARATUS.

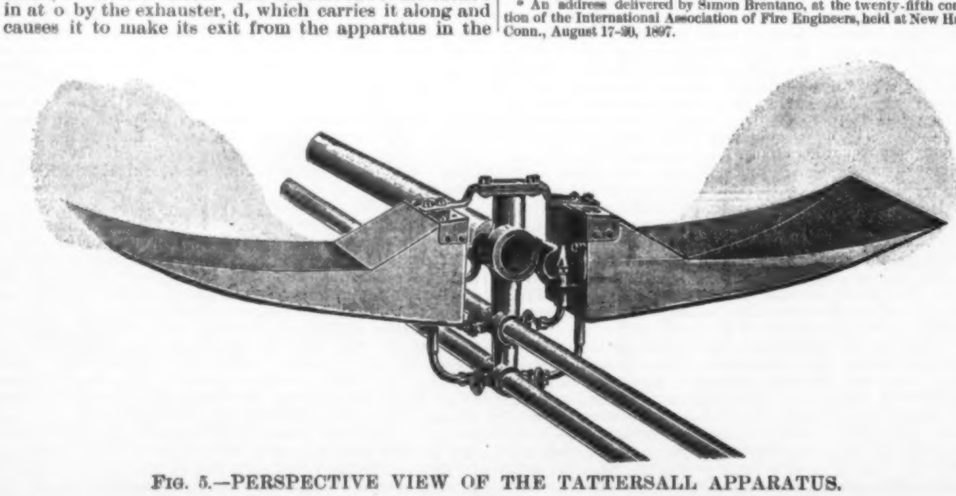


FIG. 5.—PERSPECTIVE VIEW OF THE TATTERSALL APPARATUS.

THE CONTROL OF FIRE.*

IT ought to be of special interest to correctly define the work of professional firemen. The term fire extinguishment, which is supposed to describe the work performed by our fire departments, conveys no adequate idea of the duties and responsibilities incident to the modern conditions of fire duty. For that reason I have, as on an occasion hitherto, preferred to designate all the duties of a fireman as those which have to do with the control of fire. The control of fire signifies all that we commonly ascribe to fire extinguishment and a great deal more. The uncertain attempts at fire extinguishment practiced by any one under the exigencies and the circumstances that surround the occurrence of fire, where there exists no regularly organized body of men maintained solely for the purpose of extinguishing them, separate the field of fire extinguishment, so called, from the strict application of the control of fire exercised by proficient firemen with the efficient apparatus, and by a body of men who are under constant discipline, and engaged exclusively and constantly for this duty and service. It is within a recent period of time that the control of fire has animated and guided the operations of our fire officials. Previous to the year 1865 the conditions and limitations under which firemen performed their duties forbade the present successful results, and the judgment of experienced firemen in many of our volunteer fire departments, aided by an earnest and willing corps of men, could not prevail against losses due to inefficient apparatus, a lack of discipline, and other features which combined against successful results. The elements that have contributed signally to the advance of the control of fire were a trinity of causes operating simultaneously, and from the beginning of which I date the modern period of fire extinguishment. I refer to the installation and usage of electricity in connection with the fire service, to transmit alarms of fire, and especially through the installation in its best form of the fire alarm box, permitting ready communication and announcements of fires to be communicated instantly, and giving a reasonably definite location of such fires.

Second, to the introduction of the steam fire engine, and then, as a third cause, the establishment and maintenance of a regularly organized fire department, supported entirely by the municipality, and engaged wholly and constantly in the fire service. It is perhaps within bounds to say that the establishment of a paid department, which really means the engagement and constant service of a body of men trained and skilled in the art of fire extinguishment, has done more to advance this service, and in every way has worked for the surer and readier control of fire, than all other causes. It is clear that this must forever remain so, for no apparatus, however powerful, or no other conditions can be successful, unless, after all, the work is intrusted to a body of men whose judgment, experience and skill will produce the results which these inanimate helps toward fire extinguishment are capable of rendering. It is true there are other reasons, which contribute to and supplement those mentioned, in enabling the firemen to attain a readier control of fire. Well paved streets, an efficient police department, abundant water supply, adequate width of streets, building regulations, defining materials allowable for use, and giving rules pertaining to construction, and many other matters, have an important influence upon fires. The precise thing which I mean by control of fire is its mastery with the smallest amount of loss, not money loss, since fire has no measurable sense for the purpose I mean, but the least loss of that material which may be in process of burning, and its control in the minimum of time; in other words, the least loss of what was liable to be consumed, and its extinguishment in the least measure of time. The successful control of fire carries with it the responsibility, intelligence, ability, judgment, skill and experience which will enable a fireman upon arriving at a fire to definitely and instantly conclude where his point of control will be. Of course, it is a question of contention whether fires at certain stages are controllable.

It is certain that in our larger cities the whole building art is changing to an extent that requires a readier control than has ever been exercised to prevent a calamitous fire. The height and character of the structures of prevailing type, of steel frame construction, with such immense window and light area, makes such buildings far more subject to fire externally than is commonly supposed. They are far more susceptible to fire from exposure than many inferior buildings, and the extent of a fire within them, if once communicated to them, depends largely upon the character of their contents. To understand the application of the rules for the control of fire, I would classify the risks of fire in this manner. First: The contents risk, being the fire liable to the contents of a structure. Second: Structural risk, being such fires originating in or about the building or a part of the same, as distinct from the contents. Third: The exposure risk, those fires carried by communication from the original seat of fire to other structures. I would class the conditions under which the different kinds of fire occur as follows: First: Cities densely built. Second: Towns, cities and villages, where one or two streets are densely built, and the balance of the community contains structures fairly isolated from each other. Third: Villages, containing risks sufficiently isolated from each other. Fourth: Completely isolated structures, such as manufacturing plants, asylums, hospitals, and all classes of structures built at such a distance from any other structure that in no event can they communicate fire elsewhere. It is self-evident from this classification that cities and towns must provide proper means for the ready control of fire. It is important to know what agencies exist for the control of fire other than the fire departments. The use of the sprinkler systems, which is nothing else than a local water supply in a structure, which is automatically brought into operation when a certain degree of heat is attained, is an important factor in the prevention of serious fires. The increasing efficiency of the sprinkler systems in the protection of buildings, and their contents, from loss, and the automatic extinguishment of fires through their agency, is a feature of distinct economic influence; it is especially so in the case of isolated plants, and is the best single means of protection that can be afforded. Its auxiliary work for firemen is of no less importance, and the frequency with which fires have been held in check, and remained within the control and easy extinguishment by firemen upon their arrival, makes the use of sprinkler plants a matter of much consideration in the protection of structures in our larger cities, irrespective of the excellence or proficiency of the departments therein.

The maintenance of special and direct wires to buildings to communicate alarms of fire facilitates the work of the department, and this feature of the use of the telegraph system is growing. Stationary fire appliances have not secured the respect of professional firemen. I believe that the largest cause of failure in stationary appliances is due less to the appliances themselves than to the fact that it is expected to use them efficiently with untrained help, and without having them under that regular inspection and preparation which is essential for all appliances that relate to fire. I think that the stationary fire appliances, without reasonably efficient and trained help to use them, will remain, therefore, of uncertain value, if not of actual detriment in the attempt to control fire.

The importance of locating a fire is one that strikes the mind of every experienced fireman instantly; and no fireman can claim thorough competency, unless he acquires and trains himself to the knowledge or art of discovering the exact location of a fire. This is his first main reliance toward the actual control. I trust no one will imagine that he is to look for the starting point of a fire if, upon his arrival, he finds the building on fire from cellar to roof. It certainly must be clear to all of you how essential it is, in order to secure the

* An address delivered by Simon Brentano, at the twenty-fifth convention of the International Association of Fire Engineers, held at New Haven, Conn., August 17-20, 1897.

best results, to be able to promptly locate fires. The next object in the control of fire is the proper location of companies, and assignment of officers and men. It is not my purpose to go into details and describe the operations of a fire. My main point is to establish that the rules for the control of fire must be uppermost in the mind of any one who hopes to achieve success in this direction. Some men who are successful, but who have never analyzed their methods or operations at a fire, assume that no thought or reflection is necessary. These men are fortunate in the sense that they generally exercise a correct and instant judgment, but, notwithstanding their apparent lack of deliberation, their plans and conclusions, no matter how quickly formed, are subject to a careful analysis. The danger existing in every fire, however minute, is the generation of heat and gas. It is a matter of the highest importance to remember that the process of combustion at fires causes an abnormal condition of the air surrounding the fire. The air certainly becomes changed by being charged with the heat and gases of combustion. It takes on altogether different qualities, and what these exact qualities are, and how they differ at different fires, is as yet unknown to anybody. From observations made at numerous fires, I am convinced that the atmosphere at certain stages of a fire, and especially certain parts of it, is transformed into a combustible and explosive gas, and I believe that this air is a means of actual communication of fire. By a school of writers on this subject, who have made some observations, it is believed that the air or gas is caused in a large measure, if not entirely, by reason of the water used for the purpose of extinguishment being decomposed into its original elements of oxygen and hydrogen, and that the hydrogen is the agency which communicates the spread of fire. I am convinced, on the other hand, that in the entire absence of water, this superheated air or gas accumulates, and is a dangerous agent in the dissemination of fire, and the longer a fire remains without control, the larger the quantity of air that becomes heated in this manner. Indeed, the danger of destruction to any considerable area arises in my mind from this source, since the communication of fire through this means is far more rapid than can be the control over the new territory which it has invaded; hence the extreme danger from this cause. In every fire the gas or superheated air is generated to a certain amount, and you all have experienced this, perhaps, and some of its manifestations. These consist of back draughts, the raising of roofs, the explosions in buildings, with sudden collapse, and even the superheating of air in the buildings adjoining those on fire, causing explosions, and often resulting in fire. Nothing is more essential to the control of fire than the elimination, so much as may be possible, of the chances for the accumulation of large bodies of this air or gas. Of course, the earlier a fire is controlled, the less opportunity exists for its formation.

On the subject of the control of fire, I shall now repeat, in part, the matter which I have used in a paper read before the Massachusetts State convention.

It is the modern fireman who was instrumental in affording the means and devising the methods whereby a fire is controlled. The old methods believed a fire destined to have its own way unchecked. The modern system has for its object, and succeeds in most instances, indeed, in the great majority of cases, in keeping a fire within reasonable control. What do we actually mean by the control of a fire? I define the control of a fire to mean its restriction as nearly as may be possible, under the varying circumstances attendant upon and surrounding each fire, to the actual point of origin, or to keep it within that boundary which the fire has attained at the time of the arrival of apparatus. In some instances this means that the fire will be confined to the room and to the actual incipient blaze which ignited a window curtain; in others, it will mean the complete destruction of the building in which the fire originated; again, in others, it may mean the ignition and destruction of neighboring and adjacent buildings. But at no time has the experienced fireman lost his sense of control, nor have his plans changed, except by reason of those changes forced upon him by the apparent gain of the fire over all control for the time being. But in such cases companies are assigned to new positions, the lessening points of danger abandoned, the more menacing positions strengthened, and that disposition is made in detail that evinces the sagacity, the quick and ripened judgment of the fireman, and that throughout illustrates the underlying object to be achieved, namely, the control of fire. Against what fearful odds the control is often won is familiar to you all. It must often have impressed itself upon your minds, reflecting on the changing conditions that have existed during the course of some of the fires at which you have performed duty, how the careful assignment of one company may have been the key point, or in other words, determined the control of fire. The control of fire should not at any time be confused with the actual extinguishment of fire. I have seen fires far more destructive than the occasion warranted, by reason of the fact that the proper estimate was not placed upon the chief element attaching to every fire, namely, a correct judgment as to its control. To illustrate this by familiar example, I need only point out that many fires gain and cover an area larger than they should, because upon arrival the companies, or those in charge of them, fail to recognize that the original point of fire is beyond instant control, but in the mistaken effort to extinguish this original source of fire, instead of keeping it in check, it permits the fire to extend.

The inability to view a fire and to determine at once whether or not the greater effort should not be extended to surrounding risks rather than the immediate fire itself, forms one of those errors of judgment in practice which has been, and will continue to be, a serious cause of unnecessary fire loss. Of course the control of a fire, I need not say, should be effected with the greatest celerity possible. It is, of course, a simple and fundamental law of fire extinguishment that the danger of destruction is lessened with each moment gained in the control. Most fires attain their maximum in relatively short time. I have timed several very serious fires, and I have estimated that they have reached their maximum danger point in thirty-five to fifty minutes. After that time the fire was a receding one; that is to say, the control over it was becoming manifest. A fire which, one hour after its inception, is burning as fiercely or as dangerously, and shows no sign of abatement, is a most serious fire, and portends great danger. Of course, I except from this classification structures completely isolated, certain oil fires and lumber fires, but in the main the visible signs of gain should be present in thirty-five to fifty minutes. I have seen a very dangerous fire in a five story building, about 50 × 75 feet, where the fire originated on the third floor, and at once assumed large proportions, controlled in exactly fourteen minutes, although the actual duty of fire extinguishment kept a sufficient number of companies busy for five hours subsequently. The great Bleecker Street fire in New York, which I consider to have been one of the most dangerous fires that have occurred in that city, reached its greatest danger point in forty minutes after the first alarm had been sent out. After that period of time, further danger to surrounding property was passed. If you will accustom yourselves to make some calculations as to the time of control of most fires, I am sure you will often be surprised at the quick mastering of the maximum danger. I again repeat my injunction to separate in your thoughts the method of control, and the attainment of its object, from the mere act of fire extinguishment. In many fires the matter of control and extinguishment are performed simultaneously. In many and in most serious fires the control of a fire, of course, precedes its extinguishment.

I will now allude to another simple law in fire extinguishment. It has no merit of novelty, but it has the distinct advantage of being permanently associated with any successful achievement in fire practice. The rule is one perhaps sufficiently known. It is this: Bring your water to bear as near as possible to the actual seat of fire or seat of combustion, if you expect the most successful results. It requires a specific amount of water to destroy the heat units generated by combustion; the exact amount of water to apply is, and must remain, an unknown quantity, because different kinds of fires develop different degrees of heat or develop a more intense flame at certain stages of the fire, then often the heat units at one point of a fire are enormously intensified when compared to other portions of the same fire. Accordingly, in the actual practice of fire extinguishment there is a great loss in the economical use of water, since no standard can be fixed which will make a working rule. The most efficient use of water is attained when the stream is directed at a range as close as practical conditions permit to the actual seat of fire. The waste of water is less blamable than the waste of a company's strength, which fail to use their stream or direct it to that part of a fire where it will do the most efficient service. Firemen often continue to play upon certain portions of a fire not reaching the vital part at all, or what is equally faulty, will maintain their stream constantly in the same position, when the condition which has warranted that position has passed away, and when they should have passed away with it to another point. Firemen should be reminded that a stream of water will not yet readily penetrate solid brick walls, and that every attempt should be made from the first second in taking position to make their streams effective, and to see that streams are not interrupted in their course. In this connection I allude to another law of fire extinguishment, familiar to all, that the efficiency of a fire stream is dependent in a large measure upon its volume and force; these two elements together constitute the highest efficiency of fire streams, not alone its volume, but its force of penetration. The particular reason, and there exists one, why the quality of force or pressure, as we denominate it, should have such an important influence in extinguishing fire, I am not yet prepared to assign. I do think that certain great and influencing results follow from a stream being directed with pressure, which do not take place when the same volume of water is used without that pressure. Firemen should familiarize themselves with the proper size of nozzles to use with certain pressure, and have at all times ready command of that knowledge which will enable them to secure efficient streams.

I now come again to an important point essential in the primary education of every fireman. I refer to the ability to promptly locate a fire. The term "locating a fire" means in this sense the requisite and immediate knowledge to ascertain the actual point of a fire in structures where a fire is burning, but of which the actual seat is not easily discoverable, or has not made itself manifest. We are familiar with the many flue fires traveling away from the starting point and revealing themselves so far from the fire that, unless skillful judgment is used, and quick work accomplished, the fire may appear to be extinguished, and yet the actual cause and greater fire remain unextinguished. The same suggestion applies to other fires, when buildings are heavily charged with smoke and heated gases, and where it is almost useless and indeed dangerous to start a stream until a fire has been located. The miscellaneous crowding of companies into a charged building before a fire is located is bad fire practice, and unnecessarily jeopardizes the safety of the men.

I shall touch briefly a recent development which I have noticed with some regret, and which, I believe, can with propriety be mentioned here. I allude to the greatly improved apparatus and implements which are coming into the service of firemen, but which, unfortunately, have imbued some firemen with the idea that they need never use their own brains hereafter. To those firemen relying so largely upon apparatus instead of their own minds for successful work, it is only necessary to remark that the appliances, after all, cannot supplant or make up the deficiency in human intellect.

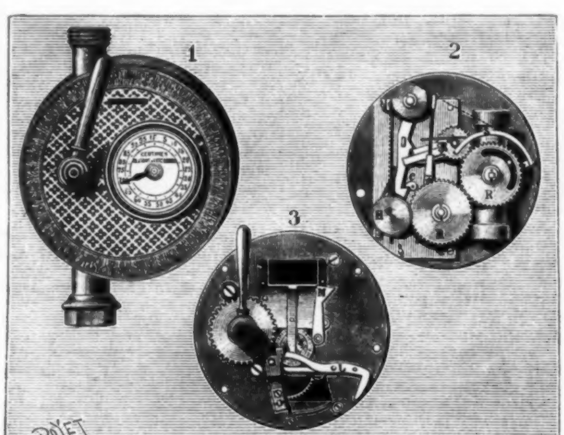
In expecting to exercise a control of fire, every fire official must bear in mind, according to the department with which he is connected, the hazard and menace which a community can be exposed to, when two or more fires occur concurrently. His provision for assignment of companies, and for the prompt relief and return of companies to quarters if not absolutely necessary at a fire, should be constantly before him.

Upon the safe protection, immunity from and ready control of fires depend the prosperity, the importance, and the happiness of a community, as much as it does upon any other department of the municipal service. Surely this will be conceded upon a little reflection.

While extending protection against fire, and aiming at the better and quicker control of fire, it is no less the duty of the fireman charged with such responsibilities to persistently, honestly, and fearlessly awaken and maintain a public interest in all that relates to his art, to the end that sufficient means are placed at his disposition to enable him to perform his duties, and to enlighten the public mind to the fact that the work of a fireman is one requiring the exercise of correct judgment, experience, skill, and other attributes, and withal a combination of such qualities that forbid the appointment or engagement of men in any capacity in our fire departments, unless they possess the qualities demanded. This is a duty that firemen owe to themselves, to their communities, and to the public at large.

THE AUTOMATIC GAS DISTRIBUTER.

THE Hour automatic gas distributer represented herewith is really a meter, but one that allows only a definite quantity of gas to flow, corresponding to the value of the coin for which it is constructed. The occasional purchaser who, through his franc or fifty centime piece, has acquired the right to burn that much money's worth of gas, regulates his consumption at his will and lights or extinguishes the gas whenever he chooses. It is possible for him at any instant to read upon a dial divided into fractions equivalent to five centimeters' worth of gas what remains for him to use.



AUTOMATIC GAS DISTRIBUTER.

As for the operation of the apparatus, that is very simple. As long as no coin has been introduced into it, the external handle is loose and disconnected with the cock that allows the gas to flow. In order that the would-be consumer may obtain a supply of gas, it is necessary for him to insert a coin of the requisite value into a slot provided for the purpose. The coin, in falling upon the lever, L, Fig. 3, depresses the latter and establishes the necessary connection between the cock and the handle. All that the consumer then has to do is to turn the latter in order to open the former. But, while doing this, he sets a spring, which, as soon as the quantity of gas paid for has made its exit, will suddenly interrupt the junction and close the cock automatically.

The simple opening of the cock suffices likewise to wind up and set a small clockwork movement in operation. A cam, C, Fig. 2, is carried along by the movement, and after finishing its revolution, frees the spring just as the last of the quantity of gas paid for is flowing out. At the same time, the coin falls into a drawer in which the receipts are stored. The lever, L, rises, and all interdependence between the handle and the cock ceases.

As may be imagined, the rotary speed of the cam must at every instant be proportional to the quantity of gas that flows out, and consequently, to the opening of the cock. This is regulated and the necessary acceleration or retardation of the clockwork movement is produced by automatically modifying the length of the pendulum. To this effect, the bob, H, of the latter slides upon its rod, thanks to a small chain from which it is suspended and that is carried along by a sector, S, pivoting upon the shell of the cock.—La Nature.

The Hungarian government has completed the necessary arrangements for the construction, without delay, of a subway beneath the Danube at Budapest on the same principle as that of the new Blackwall tunnel under the Thames in London.

SUBMARINE TELEGRAPHY—A NEW FRENCH TRANSATLANTIC CABLE.

By HENRY HAYNIE, in Boston Herald.

ANOTHER transatlantic cable is being laid from France to the United States, and very soon the French company will have two lines running under the ocean from the village of Orleans, Mass., on old Cape Cod to the city of Brest in ancient Brittany. It is not every one who can remember the earliest days of Atlantic telegraphy, that is to say, when a cable was laid from the shores of Newfoundland to the coast of Ireland, and when President Buchanan exchanged messages with Queen Victoria.

In 1879 the French republic, or rather M. Pouyer-Quertier and his friends, wanted an Atlantic cable to "secure the telegraphic independence of France," as another one, laid some time before from Brest, though undertaken on the principle of competition, had been absorbed by the Anglo-American. M. Pouyer-Quertier was minister of finance under President Thiers, and he played a prominent part in arranging for the indemnity of several billions of francs paid to Germany. Continental capitalists backed up the enterprise eagerly, but the English opposed it energetically. That French cable was landed first at St. Pierre, a matter of some 2,400 miles from Brest, and was thence continued for a distance of 850 miles more to the east shore of Cape Cod, in Eastham, and an office of transmission was established there. But two or three years back the station was moved to Orleans.

Some 1,223 separate and distinct cables, aggregating a total of nearly 185,000 miles, have been laid throughout the world in less than fifty years, at a cost of at least $165,000,000. However, we hardly ever think of the "thousand and one" submarine lines that cross coves, bays, estuaries, wide rivers, seas between islands, etc.; when we happen to speak of cables, we usually mean the great Atlantic system of telegraphy. Great Britain owns most of the great cables, operating fourteen long ocean cables, nine of which belong exclusively to her; in the Indias she owns ninety-three, and has a part ownership in five more; her home system includes 102 separate lines; and in her colonies there are forty-five, making a total of 260 cables. France operates sixty-five separate ocean cables, many of them the most important in existence. One of these is the French cable, as it is familiarly called, that has been working from old Brittany to old Cape Cod these eighteen years. Germany has forty-five cables, but they are short in comparison with those of England or France. Italy has thirty-eight. There are more cables in Sweden-Norway than in any other country, but they are all very short ones.

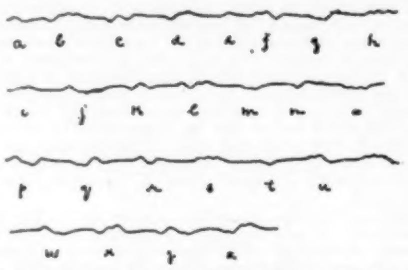
A new board of directors, under the management of M. Depelley, determined a short while back to improve the French Cable Company's facilities by reinforcing their old cable by another, and it is this new one which is now being laid. It is made up with the largest conductor ever yet laid to the United States, and it will be completed before the dead leaves finish falling. It will parallel the route of the old French cable, but so large are the dimensions of the core conveying the current that it is expected the message from France can be freely read off the siphon recorder here in Orleans without having to be written down and retransmitted at St. Pierre. The size of this coil is 700 or 800 pounds to the mile, independent of the gutta percha insulation, the manila covering and the further covering of large steel wires to protect it from material injury. To lay such a cable requires a steamer of extraordinary dimensions equipped with all kinds of electrical apparatus, as well as the most approved gearing and machinery. So the French company secured the steamship Silvertown. She is 350 feet long, 55 feet broad, 34 feet in depth, is fitted with engines of 1,800 I. H. P., and steams 10½ knots an hour, with a consumption of 30 tons of coal daily. She carries three tanks, each being 32 feet deep, and the largest is 53 feet in diameter. This tank has, consequently, over 70,000 cubic feet capacity.

When carrying 6,390 tons, the draught of the Silvertown is 28 feet. The coal bunkers have a capacity of 1,300 tons, besides which 1,000 tons of fuel can be stowed in the forehold. She has taken on board at one time as much as 2,160 knots of ocean cable. But a cable of the proportions now being laid down by the French company calls for three or four trips to complete the work. When the Silvertown pays out all the cable on board, her crew attach the end to a buoy and drop it overboard. Then she steams back to France, where the cable is made, takes on a further supply, returns to this buoy, takes up the end, makes a splice to it and so continues the work until the cable is entirely laid from Brest to Orleans.

The story of how a lost cable or a non-working one is picked up in midocean has been told repeatedly in newspapers and in magazines, but not so of the scene in a coast station where operators have to wait patiently and may be a long time for new connection with the office at the thither side of the Atlantic. The last important break in the French cable occurred last October, and it produced a delay of three weeks. "Day after day, night after night, through several weeks," said an operator to me, "one of us was always on duty watching and listening until sight and hearing were almost gone. Thrice every day and twice every night the wire was tested, not with any expectation of a message from our comrade on the steamer—it was not yet time for that—but simply to keep an accurate record of the condition of the cable. Sometimes wild messages seemed to be coming from the deep, extraordinary cablegrams in a language of gibberish that was wholly incoherent, but these were merely the results of magnetic storms and earth currents which reflected the galvanometer rapidly or jerked it to flash sentences that were nonsense. Then one morning at the end of three weeks the operator on duty observed a peculiar indication about the instrument which showed his experienced eye that a message was at hand, and in a few moments we were in communication with midocean."

The French Cable Company is represented in the United States by Mr. M. Lurienne, at New York, while the superintendent or manager of the Orleans station is Mr. H. Osborne, an Englishman, who learned how to telegraph when a mere boy in his first school days. The present writer is indebted to the latter for much valuable information. At the time of one of my visits to his office a cablegram from Father Neptune was received and handed to me. It is reproduced on this page precisely as it was traced by a curiously shaped glass pen worked by a delicate galvanometer on "the tape" or white paper string about three-quarters of an inch in width.

The cable men handle all the cable work, and there is a countercheck or record kept of all their work by the land wire men. The cable pen waves off a message, and above the line of curious looking ups and downs and curves which a delicately poised indicator traces stretches another line of words, but their lettering is broken into dots and dashes. This upper line is written by the Morse system of telegraphy, the lower or real cablegram is woven by a curiously shaped thing of hol-

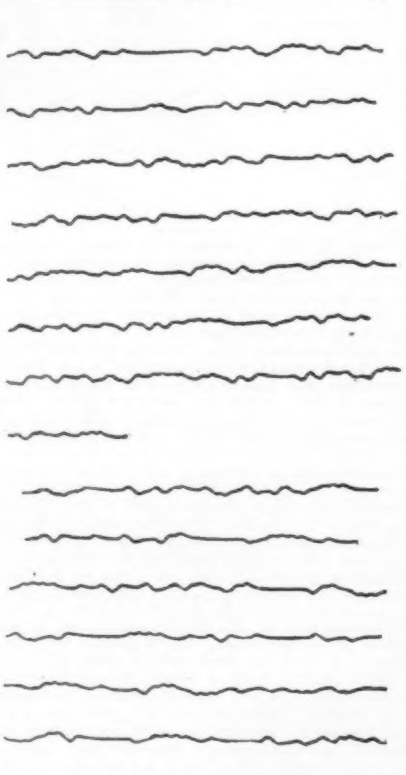


THE SUBMARINE TELEGRAPH ALPHABET.

low glass, through which flows a dark liquid, and the pen is caused to move or waver by the feeble electric current passing the galvanometer at the right hand of the operator. This instrument, the invention of Sir William Thomson (now Lord Kelvin), took the place of the much talked of and written of spark or flash telegraphy some time back.

I do not know whether any of my readers have seen in practice that old fashioned mirror system of cabling, as it was called, by which they communicated formerly across the Atlantic. If they ever visit a cable station I strongly recommend them, as a matter of curiosity, to see it, if possible, for, though no longer in use, I dare say the manager will have it in storage somewhere about the office. It is one of the most ingenious pieces of machinery that I have ever beheld, even if it is obsolete. It involved this: The continual watching of a small speck of light reflected from a tiny mirror and traveling over a diagram representing words or letters of the alphabet or something of that sort. Naturally, the strain on the eyesight was immense; it was so great, in fact, that after some years' exercise of it a man became almost absolutely incapable of turning his attention to any other mode of earning his living.

Moreover, that system of forwarding messages was necessarily very slow, and called for two receiving persons, one to read the words, the other to write them



FACSIMILE OF SUBMARINE CABLE MESSAGE.

Translation: "The Boston Herald is a great newspaper; it receives long European dispatches by the French telegraphic cables. We always read the Herald down here at the bottom of the Atlantic.—NEPTUNE."

down as called out to him. The companies, as well as the operators, were glad, therefore, when Sir William's invention enabled them to make use of the present system. If Morse signals could be sent by sound under the Atlantic, transmission of dispatches would be made more quickly and of course at less expense than is now the case. When the first submarine cable was laid under the ocean such sounds did work feebly through the line at the rate of about three words a minute, I believe, but that was altogether too slow, and was uncertain; so another method had to be invented. Thus came into existence what was known as mirror and flashlight system, just now spoken of. While it worked much more swiftly than the Morse, it could do no more than twelve to fifteen words a minute. This slowness impelled inventors to devise something else, and finally Sir William Thomson got up the present system, which is good for forty to forty-five words a minute. But attention is being constantly directed toward the utilization of sound signals by cable companies, and success will probably come eventually, though it is not yet in sight by any means.

Messages have been sent thousands on thousands of miles with wonderful swiftness. For instance, the London Globe of March 23, 1893, printed the following paragraph: "The result of the university boat race was telegraphed and received in New York three seconds after the result was known at Mortlake. This was accomplished by the French Atlantic Cable Company, and is one of the smartest telegraphic feats on record."

At the time of our presidential election in 1892 an English newspaper published in Kobe, Japan, wanted the result as soon as known in New York, and the editor arranged by correspondence with the manager in America of the French cable to forward the same as swiftly as possible. I may say that when it is midnight in New York it is only 2:15 o'clock of an afternoon at Kobe. Well, at midnight of the day of election these four words: "Herald, Kobe, Japan, Cleveland," were started from the office in Gotham. They went to Cape Cod, thence to St. Pierre, thence to Brest, thence to Paris, thence across the continent of Europe, under the Mediterranean to Africa, under the Red Sea to Asia, then through India and China, under the Sea of China to Yokohama, from which place they were telegraphed by land wires to Kobe, where they were handed to the editor, who at once put the Herald with the important news to press, and an "extra" was selling in the streets of Kobe at 4:30 o'clock. Precisely two hours and fifteen minutes had elapsed since that dispatch left New York, and I daresay as much time was consumed in getting it from Yokohama to Kobe, setting it up in type, and printing it as there was in transmitting it from the United States to Japan.

It is not so very far from here to Boston, straightaway, but as yet cablegrams from Europe addressed to your city are not sent directly there. In the summer of 1895, while in Portland, Me., I had occasion to send a telegram to Bar Harbor, some distance to the east-northeast from that place. When the message was handed in and paid for, the gossiping clerk said it would have to be sent to Boston first before it started on its way to Bar Harbor. This, I thought then, was quite a "roundabout way" of reaching that resort; but it was a mere nothing as compared with the flight of a telegram from Orleans to Boston. All messages from Europe are distributed only from the New York office, so I was informed at the cable station. It is the intention to open a cable office in Boston soon, and before this is done a land wire will be constructed from this village to the capital of the commonwealth; meanwhile all dispatches must go to the metropolis. We will suppose that Ambassador Porter wants to communicate with the editor of the Boston Herald. He files his message in one of the many telegraph bureaus that are scattered over Paris, and it starts on its long voyage straightaway to America. The course is due westward to the island of St. Pierre-et-Miquelon, off Newfoundland—owned by the French republic; but thence the submarine cable runs southerly to Cape Cod and finally reaches Orleans, about 65 miles from Boston in a direct course. Received there and recorded, the diplomatic communication to our fourth estate is not, however, sent directly on to its destination. Instead, it takes its way the whole length of Cape Cod to the mainland of Massachusetts, goes out of that State into Rhode Island; out of that and into Connecticut; thence into New York State beyond Stamford, and, by and by, reaches the island of Manhattan, where another record and transfer are made of the message. This done, it is "rushed" toward Boston. Again it travels in four States, and finally, after having been flashed along something like 500 miles of land wire since it came ashore at Orleans, it reaches its destination in the Boston Herald building.

This "circumlocution" and its attendant delay, not to mention the annoyance of being thus compelled to be subordinate to Gotham, will disappear altogether when the French company opens its Boston office, and enters into competition with the Commercial, the Western Union, the Anglo-American, the Direct and all the other lines. For though the rates are precisely the same on all of them from Boston to Paris or to London, there is competitive rivalry, and business is keenly sought for by each company. Said the manager:

"Though I cannot reveal to you any details in the commercial transactions of this company, I may state that our traffic has not materially suffered from the recent business depression, and I think we have had a fair share of the messages between America and Europe, both ways. Our precise percentage of the entire traffic as compared with the percentage of it which the Anglo or some other company secured is an office secret, but I repeat we have no reason to complain; quite the contrary, in fact. When the new cable is down, when we have our own office in Boston, and a land wire thence to this station, our share of the whole will be considerably increased, while the public and the press will have a much better service than ever."

The first charge for messages through the Atlantic cable, from New York to London, or vice versa, was $100 for 20 words; this rate was reduced after some time to $50 for 10 words, and by 1875 the tariff had got down to $1 a word. A new company completed a cable in 1875, and then a rate of 75 cents a word was established. The French Cable Company—Le Compagnie Francaise du Telegraphe de Paris à New York—landed its cable on the shore of Cape Cod in 1879, and effected a reduction of tariff to 50 cents; it is now 25 cents a word to either London or Paris.

But the cost of cabling a dispatch to some place in Japan or China, or, indeed, to any country on the western coast of the Pacific Ocean, would be very great. The message would have to be sent over 3,000 miles due east before it could commence feeling its way toward Japan or Australia. Such a dispatch sent from San Francisco would have to cross the American continent,

the Atlantic Ocean, Europe, a part of Africa, and all of Asia, together with numerous intermediate seas and other oceans before it reached Yokohama or Melbourne. The cost per word would be as much as $2.85 to Auckland, or $2.35 to the capital of Japan.

THE MASSENA WATER POWER ELECTRICAL GENERATING PLANT.

IN our issue for August, says the American Electrician, announcement was made for the commencement of work on the canal of the St. Lawrence Power Company at Massena, N. Y., and we are now enabled to

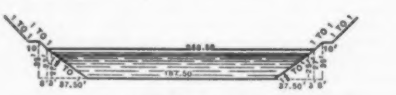


FIG. 1.—SECTION OF CANAL.

give an account of some of the more important features of this great undertaking, which involves the immediate utilization of 75,000 horse power, with a prospective utilization of 150,000 horse power.

Fig. 5 is a map showing the location of the plant and canal and Fig. 1 is a section of the latter. The St. Lawrence River has a fall of more than 50 feet over the Long Sault rapids between the mouth of the canal and the point where a small stream—the Grass River—flows into the St. Lawrence. The canal will connect the St. Lawrence with the Grass River at a point of the latter where the water will have a fall to its bed of 47 feet, of

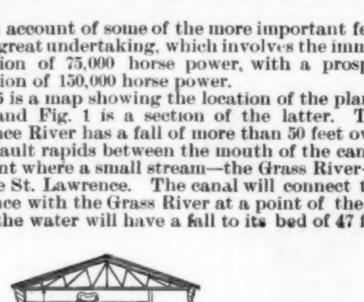


FIG. 2.—SECTION OF POWER HOUSE.

which there will be available at the turbines an effective head of over 40 feet.

The power house will be built on the bed of Grass River below the canal outlet, and will be 600 feet long by 130 feet wide. Fig. 4 shows a plan of the power house and Fig. 2 a transverse section. The turbines will be of the horizontal shaft type, two to each shaft and each pair developing 5,300 horse power. Fig. 3 shows the setting of the pairs and the draught tubes.

The turbine shafts, which are 80 feet long, will extend through a wall separating the canal or turbine chamber and the power house. Each shaft will have mounted

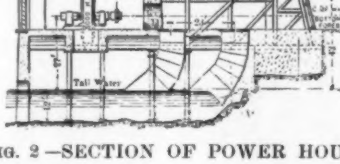


FIG. 3.—ARRANGEMENT OF DYNAMOS AND TURBINES.

on it a great ring of steel, which will carry on its circumference twenty external pole pieces, the ring and pole pieces being of one solid casting of steel. The former will have an extreme diameter of 15 feet and be about 3 feet wide and supported by a massive hub having ten radial arms or spokes. Each of the machines will weigh 350,000 pounds, stand 22 feet high above the top of the foundation and occupy a floor space of 22 feet by 18 feet.

The stationary part of the dynamo will form the armature and will consist of a large ring or cylinder, the inner surface of which will be made up of plates of soft, thin steel on edge held by the massive outer ring of cast iron. The inner surface of the steel plates will have slots in which will be laid copper bars parallel with the shaft of machine, insulated from each other with mica and in which will be generated the three-phased currents.

The poles of the revolving portion or field of the machine will be wound with copper ribbon. The speed will be 180 r. p. m. and the current will be generated at a frequency of 30 periods per second.

The owners of the St. Lawrence Power Company are Messrs. Stewart & Company, 40 Wall Street, New York. The engineer is Mr. John Bogart, formerly New York State engineer.

Contracts for construction of the plant have been let as follows: For excavating the canal, building the power house and hydraulic work, to the Lehigh Construction Company, Limited, of South Bethlehem, Pa.; the fifteen 5,000 horse power generators will be furnished by the Westinghouse Electric and Manufacturing Company; and the turbines by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O. Seventy-five thousand horse power electrical energy are to be available before the end of next year.—American Electrician.

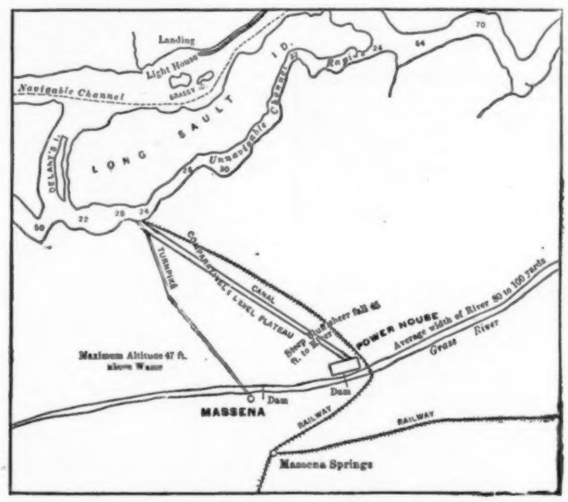


FIG. 5.—MAP SHOWING LOCATION OF CANAL AND PLANT.

THE MAGNETIC DIP OF ANCIENT TERRA-COTTAS.

THE article on this subject contributed by the Cavaliere Giacomo Boni to the Journal of the Royal Institution of British Architects, June 17, 1897, is of great importance, says the Builder. Dr. Folgheraiter's experiments have proved that clay cylinders acquire during the period of cooling after being baked a permanent magnetism, owing to induction by the earth's magnetic field. If we know the position in which a terra-cotta vase, for example, has been baked and determine the direction of the field of its remanent magnetism, then we know the "dip" of the earth's magnetic field at the period at which the vase was baked. If we know the "dip," then, as it is always slowly changing, it will be a great help in fixing the date of the vase. Conversely, if we know the date of the baking and the position in which it was baked, then we can find the "dip" at that period. Prior to 1576 we have no records of the magnetic "dip." Since that date it attained a maximum value of 74° 42′ in 1720, and then gradually diminished to its present value of 67° 30′. Dr. Folgheraiter found that four terra-cotta cistae of about the eighth century B. C. show distinct traces of south polarity about their bases, which is strong evidence that at the time and place where these vases were baked a magnetic needle would have dipped toward the South Pole. The Cavaliere Giacomo Boni points out the necessity of further experiments in this direction. He suggests that brick walls which have been subjected to fire at a known date, e. g., the great council hall of the ducal palace in Venice, burnt A. D. 1575, should be examined for traces of remanent magnetism. If we can thus determine approximately the "dip" at the period of the fire, it will be an obvious example of the value of the method. A more promising suggestion is to examine magnetically volcanic rocks due to eruptions of historical date. At Herculaneum, for example, there must be plenty of strongly magnetic substances which came in contact with the lava, by examining which the magnetic dip at the date of the eruption might be ascertained.

Members of the Royal Institution of British Architects are asked to give notice of any buildings they may happen to come across which exhibit traces of magnetism induced at some former period. In a note Dr. Folgheraiter's method is described, presumably for their instruction. It is very difficult for any one but an expert on laboratory methods to understand it. It is of no great use, except as a laboratory method of determining the magnetism of something like a vase uniformly magnetized. The mysterious "areotg." mentioned is a misprint for "aretg.," or, as we write it in England, tan⁻¹ From experiments of our own on a block of asbestos, afterward found to contain traces of magnetite, we found that it was very irregularly magnetized; the lines of force seemed to radiate in all directions through the body. Baked clay, we imagine, contains considerably less than ten per cent. of the ferrous ferric oxide, which constitutes its magnetic substance; it will, therefore, be a very feebly magnetic body, and it will be very difficult to determine the direction of its remanent magnetism, especially if it is not uniform.

Electricians can determine to within one per cent. the strength of the current in an electric cable by means of a little compass, such as is often worn as a "charm" on a watch chain. Architects often use such a compass to determine the position of an iron girder or a gas pipe. A sensitive compass on this principle might be employed to detect whether there is anything abnormal in the magnetic field in the neighborhood of an old building or a monument. An expert could then find out the cause of this, and, if possible, determine the direction of the feeble remanent magnetism. It is highly probable that some curious instances of magnetic effects might be discovered by this means, if several people systematically experimented with this end in view. At any rate, speaking from experience, we can say that it is no waste of time to learn how to use a charm compass scientifically.

A NOTE ON SOME OF THE REQUIREMENTS FOR A SANITARY MILK SUPPLY.*

By WILLIAM T. SEDGWICK, Ph.D.

IT is now generally recognized that the milk supply problem is one of the most pressing in American sanitation, and I am frequently asked to give an opinion as to the merits of this or that remedial measure. I have therefore thought it worth while to lay down very briefly, but I hope clearly, the fundamental principles which must be carefully kept in mind in seeking to introduce sanitary reforms into this important industry.

The fundamental, indispensable and all-controlling requirement of a sanitary milk supply is that milk, when consumed, shall be as nearly normal as possible. Normal milk is milk as it flows from the mammary gland of a normal animal, and a normal animal is obviously one that is healthy and well fed. From such an animal under normal conditions the milk supply of its young passes almost instantaneously, and without exposure to dust and air, from the milk ducts of the mother to the stomach of the suckling. Such milk is absolutely fresh, warm and free from dirt. It is not only undecomposed, but nearly or quite free from the germs (bacteria) of decomposition.

Ordinary city milk, on the contrary, is neither fresh, warm, nor free from dirt, and if not already far on the road toward decomposition, is always richly seeded with bacteria. It is not always derived from healthy or well-fed animals, and is seldom drawn under clean and sanitary conditions, so that even at the outset it may be, and often is, very far from normal. It is also too often transported over long distances, so that it still further loses its original freshness, and it is frequently manipulated by unclean, and sometimes by diseased, workmen. By the time it reaches the consumer, therefore, it is not only no longer normal milk, but usually stale, dirty, more or less decomposed, and sometimes also diseased.

Some of the steps to be taken in securing a more sanitary supply are easily deduced from the foregoing facts, and are as follows:

1. Milch cows should be healthy, well fed, well kept and well cared for.

2. Milk should be derived from such cows only, and with all possible precautions in regard to sanitation

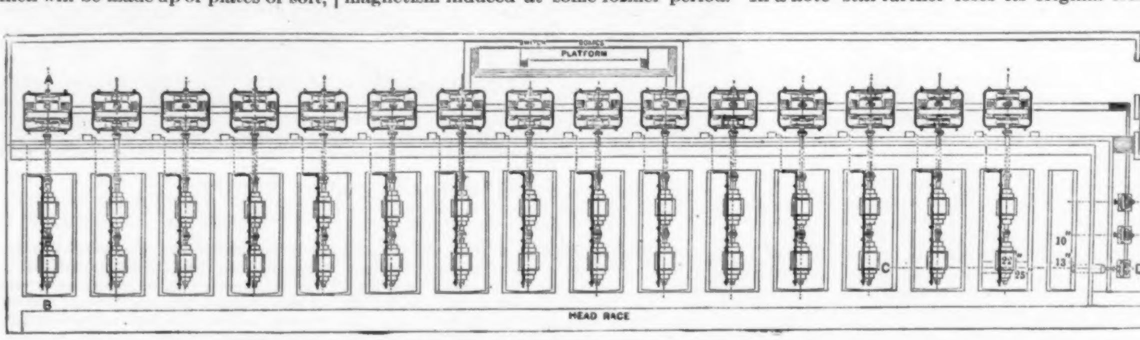


FIG. 4.—PLAN OF POWER HOUSE.

* From the Technology Quarterly of the Massachusetts Institute of Technology.

and cleanness. Cows as sources of food should be tended as carefully as or more carefully than horses used only for burden or pleasure. The operation of milking should be looked after with special care. Above all, the hands of the milker should be carefully washed just before he begins to milk, his own personal cleanliness being even more important than that of the cow.

3. When drawn, milk should be immediately filtered and chilled, as means of retarding decomposition, and all articles with which it comes in contact, such as filters, pails, cans, etc., should be scrupulously clean.

4. The milk thus prepared should be delivered, if possible, at once.

5. If it is impossible to deliver the milk immediately, it will be impossible to deliver normal milk, and such milk cannot, in fact, generally be obtained in cities. The best that can be done, probably, is to deliver as speedily as possible two kinds of milk, viz.:

(a) The milk thus far described, kept as nearly normal as the conditions will allow.

(b) The same milk carefully pasteurized either (and preferably) on the farm where it is produced or at some central point accessible from a number of farms, or, if this be impracticable, at some good distributing point in or near the city to be served.

The former (a), which may be called "chilled milk" or "raw milk" or "ordinary milk," will be preferred by some. The latter (b), which may be called "pasteurized milk" or 'sanitary milk," will be preferred by many as being certainly free from the germs of infectious disease.

There can be no doubt that any individual or company which honestly strives to displace the present highly objectionable milk supply of American cities by a supply such as has been here described deserves, and will secure, the support and the confidence of the more intelligent portion of the community.

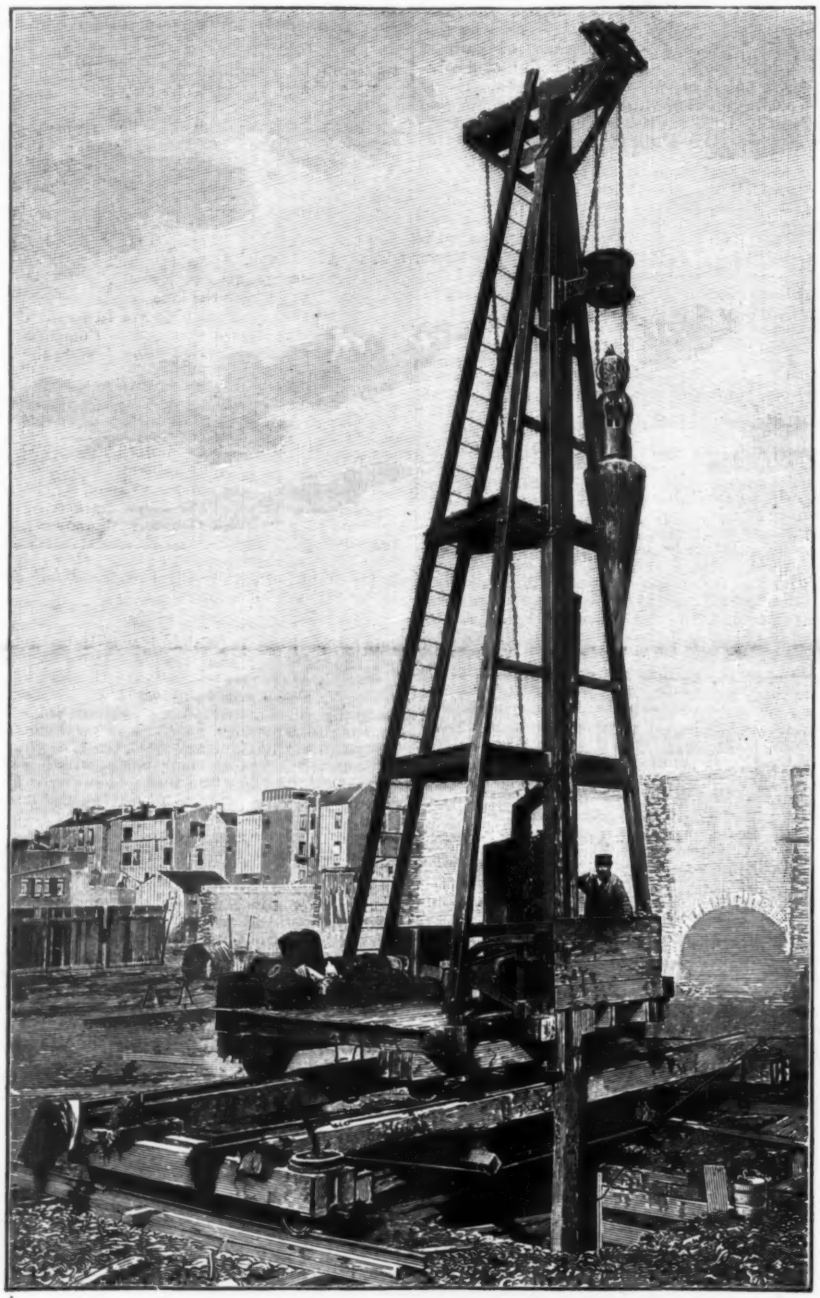
THE PARIS INTERNATIONAL EXHIBITION OF 1900.

THE preparatory work of a great international exhibition like that which is to be held in Paris in less than three years is as interesting as its ultimate installation. Not the least considerable of these preparation works are the many buildings of all kinds in which exhibits will be placed; the extensive works which have to be carried out to facilitate the convenience and circulation of visitors; and the complicated organization necessary for the transport and handling of exhibitors' goods and cases. Progress has sufficiently far advanced to enable us to take some note of the first named preparations. The various works of demolition are being actively pursued, among them especially the central dome in the Champs de Mars, of which the steel framework is being removed girder by girder by means of a timber staging about 300 ft. in height, erected inside the building. This staging has been constructed with a clear internal space to facilitate the lowering of heavy weights, one of which is the gigantic statue of repoussé zinc which stood on the summit of the dome, and the weight of which is about 9 tons. The removal of the Palais de l'Industrie is also rapidly progressing.

The new constructive works are advancing, although at present they are chiefly limited to foundations of the new palaces; at the same time the architects of the two Fine Arts buildings are constructing plaster models of them, one-hundredth full size. By means of these models it will be possible to form an exact idea of the architectural effects and decorating details, and to introduce any changes or modifications before the buildings are actually constructed. It is considered that the expense thus incurred will effect considerable economy in the end, and that the definite results must be more satisfactory. The models are well advanced toward completion, and the contract for the main façade of the principal palace has been let. It is a heavy undertaking and will cost at least a million and a half francs. One of the most interesting features at the present time is the preparatory work for the new bridge over the Seine—the Pont Alexandre III. Already the quays on each side of the river are opened up and excavations for the abutments are in progress. The inclosure of sheet piling on the right bank, within which the foundation caission will be placed, is almost completed.

The erection of the caisson is well advanced. The method of building the foundations is by compressed air. These foundations will be actively pushed forward as soon as the air conduits are laid, and it is an interesting detail that the supply will be furnished from one of the mains of the Paris Compressed Air Company. As for the superstructure of the bridge, the designs are now completed and the whole work will be offered for contract in the course of the present month.

As we said above, the constructive works connected with the 1900 exhibition are of great interest and almost of infinite variety. Even the very temporary buildings forming the engineers' offices connected with the Alexandre Bridge possess some features of interest; they are of iron, the framework being covered by stamped plates of such a form that when put in place a continuous air space is provided between the inner and outer walls. This arrangement has already proved effective in periods of great cold or intense heat, while later on, when it is necessary to remove the buildings, the work can be completed with great expedition. Of a more important character than these temporary offices are the structures intended for the various bureaus of administration, executive, and architecture, preparations for which are now being made on the bank of the Seine, between the Champs de Mars and the Esplanade des Invalides. Some old structures without any actual use, and of which many are to be found in Paris, are to serve for these offices; they are the buildings known as the Ecuries de l'Alma, the sumptuously fitted up range of stables which at one time accommodated the horses of the Emperor Napoleon III. While part of these stables are being transformed into offices, it is also necessary to construct new buildings in the courtyards. A difficulty, however, was found in carrying out this work. The banks of the Seine are formed of stone and earth filling, resting on fine sand, easily washed out during periods of floods. Just where the new office buildings have to be erected this sand is particularly without consistence, and is absolutely unsuitable for foundations; at a relatively considerable depth, however, a solid stratum exists. In order to adapt the ground a new and very interesting system has been adopted—the invention of a well known French engineer, Mr. Louis Dulac. Some time since this engineer, wishing to erect a factory very cheaply, purchased land made up entirely to a depth of about 16 meters of rough filling of all kinds, quite unsuitable for foundations. Mr. Dulac, however, resolved to erect some very heavy structures, 3,000 square meters in area, with walls 12 meters in height and a chimney 30 meters high. He accordingly devised a very simple and inexpensive means of compressing this loose soil and making it suitable to carry the heavy weights just referred to, by means of the device illustrated. The system consists in forming holes in the ground by means of a species of pile driver, the falling weight of which is of the special form shown in the illustration; and afterward of filling these hôles with hard material of small dimensions, the agglomeration of which in successive beds provides an entirely satisfactory foundation. The consolidation of bad ground en masse is certainly a novel and interesting idea, and the Dulac process appears to secure this up to a depth of at least 14 meters. To obtain the necessary consolidation of the



DULAC'S PILING ENGINE.

ground a series of wells are sunk 31 in. in diameter and spaced about 6 ft. apart from center to center; these wells are then filled with lime or cement concrete, which is rammed hard by the falling weight, and form a series of monolithic columns anchored into the ground, the concrete to some extent spreading into the sides of the wells.

In order to sink the shafts, a conical pointed falling weight is employed, which, as will be seen from the illustrations, has somewhat the shape of a large carrot; it weighs 1½ tons, and falls freely without guides from a height of 10 or 12 meters. It is worked by means of an ordinary piling engine, the frame of which, mounted on wheels, runs upon suitable rails. The falling weight is furnished with a steel point, the upper end has a suspension stem. When the hoisting chain of the piling engine is lowered, a catch with three branches surrounds the head of the weight automatically, and when the chain is raised the jaws close around the weight, holding it fast. As soon as the weight is raised to a certain height the jaws come in contact with a trip gear on the vertical frame of the piling engine, releasing the weight which, falling freely, penetrates 20 in. and sometimes more into the bottom of the well. The process is then repeated, as we have described.

Three types of falling weights are employed, each of them fitted from the same hoisting and releasing gear. The first of these types is the conical form, of which we give an engraving. With this a well 31 in. in diameter can be sunk to a depth of 12 meters in five hours, and the operation so compresses the earth around the well that the latter will hold water when poured into it.

After this the second type of weight is employed. It weighs 1 ton, and has something the form of a shell with its point downward. Naturally, this type is not adapted for boring, but is intended to ram the material that is placed in the well. This material consists of old rubbish, such as broken bricks, etc., in layers, 20 in. or 30 in. thick, alternated with similar layers of béton mixed with hydraulic lime or cement. Each layer is rammed hard by the falling weight, which drives the filling against the sides with the effect that it enters the earth surrounding, and forms a column considerably larger than the diameter of the well. It is, of course, necessary to ascertain whether the column thus formed possesses sufficient resisting power to carry its proportion of the weight of foundations, and for this purpose the third type of falling weight is used. The resistance can be easily ascertained by the amount of penetration into the mass of the column made by the weight falling through a fixed distance a certain number of times.

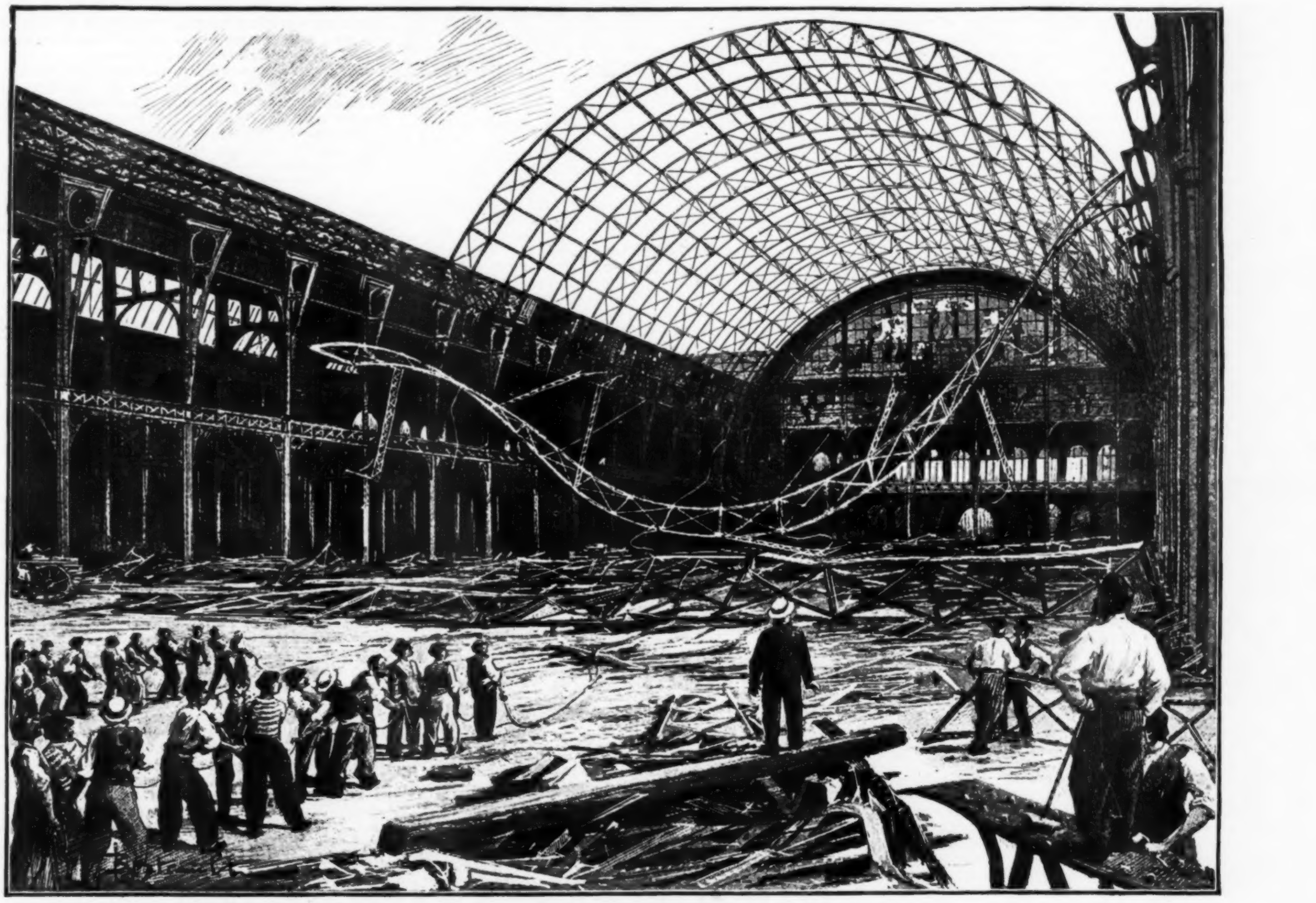
Where the ground has a sufficient degree of solidity, or where the weights to be supported are not great, the second type of falling weight only is used; with this wells 2 meters deep can easily be bored and the material rammed without changing the weight. In ground possessing very little cohesion the same form of weight must also be employed, as the first type is apt to go out of sight and be lost. With this system a bed of clay 40 in. thick can easily be traversed, the material being forced out both above and below. For thick beds of clay, however, it does not prove serviceable. As to the cost of the operation, it would appear that for a well varying from 1 to 5 meters in depth, the expense would be 15 francs per yard run, with a mixed filling of rubbish and lime, 20 francs for lime concrete, and 25 francs for cement concrete.

We have said that Mr. Dulac first experimented with this system on his own account, and he was able to

construct buildings exerting a load of nearly 4 tons per foot upon ground which previously would not carry one-tenth of that amount. He afterward erected a building weighing about 8 tons per square foot upon land where the first fall of the boring rake had thrown up a jet of semiliquid mud to a height of about 30 ft.

The foundations of the new administrative buildings for the exhibition are the latest executed on this plan. There is little else of interest in the structures, which are formed with steel frames, arranged to support slabs of plaster in which are embedded strips of expanded metal or its equivalent; the foundations, however, are of considerable interest, and form one of the many novelties in construction which will be conspicuous at the exhibition of 1900. It may be mentioned that the ultimate strength of the columns is about 20 tons per square foot, and that infiltration of water has been prevented by ramming the holes with broken stone set in hydraulic lime.

For the engraving and the foregoing particulars we are indebted to Engineering, and for our engraving of the demolition of the Palais de l'Industrie we are indebted to L'Illustration. This building is on the south side of the Avenue des Champs Elysées. It was built for the first Paris Exposition in 1865, and the idea was adapted from Sir Joseph Paxton's iron and glass buildings. It forms an immense rectangle, the central building having a handsome elevation surmounted by a colossal group of sculpture, by Regnault. The building, with its long wings, consists of two stories and is adorned with various medallion portraits. The central hall is 51 ft. in height and 632 ft. in length. The building has been used for various scientific and other congresses, and is notable as being the gallery where the famous annual French exhibition called the Salon has been held. The building was so well built that it was removed only with great difficulty.



THE DEMOLITION OF THE PALAIS DE L'INDUSTRIE, PARIS.

[Continued from SUPPLEMENT, No. 1133, page 18115.]

ALFRED MARSHALL MAYER.*

AMONG the acoustic discoveries of Prof. Mayer may be mentioned his observation that the sensation of a sound may be obliterated by the simultaneous action on the ear of another sound of greater volume and lower pitch, but that the converse is not true. The higher pitch, even when intense, cannot obliterate the sensation of another sound of lower pitch. This does not imply that the higher pitch is thus always completely obliterated. Its presence modifies the compound perception after the possibility of singling it out has vanished. The apprehension of this truth caused him to suggest certain changes in the method of conducting orchestral music, but they were not adopted on account of counterbalancing inconveniences in practice.

In 1876 Prof. Mayer discovered that the air pressure on the inner surface of the bottom of a resonator in action exceeds that on the corresponding outer surface. This led to the construction of the "sound mill," composed of pairs of resonators so balanced and pivoted on their supports as to be set into rotation by reaction on sounding near them a tuning fork to which they are adapted. This phenomenon of acoustic repulsion was shortly afterward discovered independently by Dvořák in Austria. Another application of resonators by Prof. Mayer was in the invention of the topophone, an instrument with which the direction of sound at sea, such as that of a fog horn, could be determined with a close approximation to accuracy. His last publication in acoustics was on the production of audible beat tones from two vibrating bodies whose frequencies are so high that the separate tones are inaudible. This paper was read at the Oxford meeting of the British Association in 1894. The existence of such beat tones has been doubted by some. In the present case I was associated with Prof. Mayer during some of his experiments, and had previously had considerable experience in the use of the sources of sound which he employed. As to the reality of the results he claimed there cannot be the least doubt on the part of any person possessing ordinarily acute powers of hearing, who will take the trouble to repeat the experiments.

The study of the physiology of sensation tempts to the investigation of the problems of vision in connection with those of audition. During the winter and spring of 1893 Prof. Mayer became much interested in the phenomena of simultaneous color contrast, of which it may yet be said that no satisfactory explanation is provided by any existing theory of color vision. It has been common to assume that the modification of color perception induced by contrast is due to unconscious motion of the observer's eyes, to error or fluctuation of judgment, or to incipient retinal fatigue. Prof. Mayer devised a variety of methods of presenting these phenomena with unexampled vividness, and on so large a scale as to enable him to arrive at quantitative statements of such subjective color by comparison with standard hues with which they were matched on the revolving color disk. Vivid contrast hues were readily perceptible when the illumination was secured by means of a momentary electric flash, and with entire accordance between different observers who had been purposely misled to expect something different from what they actually perceived. The hypothesis of retinal fatigue, or fluctuation of judgment, or ocular motion, is excluded under such conditions. This psychological element of color contrast led to the development of a disk photometer for measurement of the brightness of colored surfaces. In the use of it a degree of accuracy was attained in excess of that usually found possible with the Bunsen photometer.

While still at the Lehigh University Prof. Mayer began investigations on electricity, on magnetism and on heat, which were resumed from time to time during subsequent years in the intervals between his acoustic researches. His lecture notes on physics were published serially in the Journal of the Franklin Institute, and, subsequently, put into book form. He devised a zero method of comparing the strengths of electromagnets and electrical conductivities, made many observations on magnetic declination, and improved on previously known methods of fixing and photographing magnetic spectra. He undertook an elaborate research on the effect of magnetization in changing the dimensions of iron and steel bars—an effect discovered by Page in 1837, investigated by Joule in 1842 and then neglected for thirty years. It was about this time that an unusually large electromagnet was constructed for the Stevens Institute of Technology, and was employed with much effect in public lectures. One of these, entitled "The Earth a Great Magnet," was given by invitation of the Yale Scientific Club and, subsequently, published. In connection with it a special form of lantern galvanometer was devised for vertical projection, which attracted much notice. Another lecture demonstration which a few years afterward attracted general attention was that of the configurations formed by magnets floating vertically and subjected to the attraction of a superposed magnet.

The multiple or oscillatory character of the electric discharge from a Leyden jar was discovered by Henry in 1842. It was carefully studied afterward by Feddersen, who used a revolving mirror, and yet more fully by Rood, who employed several methods, but more particularly that of the revolving disk with radial slits. Prof. Mayer, in 1874, took advantage of centrifugal action to give steadiness to a disk of blackened paper rotated rapidly between the electrodes employed for transmission of the spark. The perforations were then subjected at leisure to micrometric measurement. Since the rotation of the disk is known, the means is thus afforded for measuring the duration of the discharge and the intervals between the successive sparks which compose it. The conditions were then studied for securing the most nearly simple discharge possible. This served as the necessary antecedent to the successful employment of the induction coil in conjunction with a method previously devised for measuring minute intervals of time with the tuning fork, or rating a tuning fork by comparison with a standard clock. The combination formed an admirable chronoscope for a variety of purposes, but more especially for measuring the velocity of projectiles.

On the general subject of heat Prof. Mayer published several articles. The first of these, in relation to waterfalls, has been already mentioned. In 1872 he devised a method of tracing the progress and determining the boundary of a wave of conducted heat by taking advantage of the variation in color with change of temperature which is characteristic of certain double iodides. The same method was applied three years afterward to the securing of thermographs of the isothermal lines of the solar disk. In 1890 he gave publication to a paper on the determination of the coefficient of cubic expansion of a solid from the observation of the temperature at which water in a vessel made of this solid has the same apparent volume as it has at 0° C., and on the coefficient of cubic expansion of a substance determined by means of a hydrometer made of it. The method was applied to several different substances, including brass and vulcanite. This led to a general investigation of the properties of vulcanite, which was published soon afterward. One of these properties is its remarkably large coefficient of expansion, exceeding that of mercury.

Soon after the publication of Roentgen's discovery of a new species of radiation Prof. Mayer's interest in this was aroused, and in June, 1896, he published the outcome of his investigation of herapathite, which had been employed by him to test the possibility of polarizing the Roentgen rays. Formulæ were deduced for the transmissive powers of several substances for these rays,

* By Prof. W. Le Conte Stevens, in Science.

including tourmaline, herapathite, glass, aluminum and platinum.

Prof. Mayer's last scientific work was an experimental investigation of the equilibrium of the forces acting in the flotation of disks and rings of metal, and an application of such rings to the determination of the measure of surface tension of liquids. The method was wholly new, and the agreement among results was remarkable. At best, it has been difficult in the past to secure reliable results in work of this kind, and the present work is fully equal, if not superior, to the best hitherto accomplished by Plateau and Quincke. It was done during the intervals between periods of acute physical suffering, and its appearance in the American Journal of Science for April of the present year preceded by only a few days the paralytic stroke which demonstrated that the investigator's life work was already ended.

In this brief sketch of Prof. Mayer's labors but little has been said of his numerous happy devices for lecture demonstration. His restless ingenuity was ever ready for any demand, and his mechanical aptitude was so directed by a delicate æsthetic sense that he could never be satisfied with any objective proof which was not neat and simple, as well as adequate. A few of these he published from time to time. Among them may be mentioned methods of measuring the angle of inclination of the mirrors employed in Fresnel's interference experiments; of obtaining a permanent trace of the oscillation plane of the Foucault pendulum; of registering and exhibiting the vibration of rods; of deducing the fundamental laws of electric repulsion by means of the pendulum; of measuring potentials and specific inductive capacities with the spring balance electrometer; of proving Ohm's law, and of expressing electric potential as work. Many of his demonstrations in acoustics were gathered into a small volume on "Sound," and have thence been copied into the elementary text books of to-day. The same may be said of a little volume on "Light" prepared with the co-operation of Mr. Charles Barnard. In the student laboratory he was as efficient as in the lecture room, fertile in devices and ever insistent upon a high standard of accuracy. No one knew better than he that demonstration and practice work are of insignificant value in comparison with investigation; but he kept always in mind the fact that, in America at least, the physical investigator is nearly always compelled to be in some way a teacher, and that in teaching physical science demonstration and theoretic instruction must go hand in hand. He was conscious of his skill and, naturally, took keen pleasure in exercising it successfully. That in so doing he gave pleasure and help to others is manifested by the extent to which his methods have served as models.

The manipulative skill and tactile delicacy which are so necessary as adjuncts to independence and ingenuity in the laboratory were applied with no less success by Prof. Mayer in outdoor recreation. Early in life he became an accomplished marksman; and during manhood, as long as good health lasted, he was an ardent and exceptionally successful sportsman. His field and laboratory interests were combined in his application of the tuning fork to the problems of gunnery. In the Century Magazine he published a number of articles on sporting subjects. These were incorporated, along with contributions from other sources, in a volume entitled "Sport with Rod and Gun in American Woods and Waters." This volume was edited by Prof. Mayer, and for it he specially prepared two valuable articles, one on "The Shot Gun" and another on "The Blow Gun."

In addition to these literary labors, Prof. Mayer contributed many articles to the cyclopedias of Appleton and Johnson, besides occasional popular articles on scientific subjects for other media of publication. In acknowledgment of his earlier contributions to science the degree of doctor of philosophy was accorded him in 1866 by Pennsylvania College. He was admitted to membership in the National Academy of Sciences in 1872, and was a member of each of the leading scientific societies of America, besides being a corresponding member of the British Association. He served during one year, 1873, as an associate editor of the American Journal of Science, and during the first eight months of that year five articles from his pen appeared in its pages. The partial failure of his eyesight then necessitated cessation from all work, and a considerable part of the next scholastic year was spent in England, where his reputation had preceded him and where hospitable entertainment was accorded by the most prominent representatives of science.

In the closer circle of personal friendship it is hard to speak with impartiality while the sense of bereavement is still fresh. A man's personality penetrates into all that he does, into his writings quite as unmistakably, if less positively, than into his conversation and the atmosphere of his home. In a eulogy on Joseph Henry, to which I listened at Cambridge just seventeen years ago, Prof. Mayer said: "His best eulogy is an account of his discoveries; for a man of science, as such, lives in what he has done, and not in what he has said, nor will he be remembered for what he has proposed to do." In comparing Henry with Faraday he remarked: "Each loved science more than money, and his Creator more than either." Mayer proved himself a worthy pupil of Henry, and their friendship grew in strength until broken by the last great Destroyer. His words may now be properly applied to himself. The characteristics of the gentleman, the high toned man of honor, were born in him. They needed no cultivation beyond the natural development and confirmation which accompany the attainment of maturity. Those who were favored with his friendship need no reminder of his generosity, his ready sympathy, his quick insight and hearty appreciation, his enthusiasm verging sometimes almost upon that of boyhood.

The value of Mayer's work will be tested by time. For some parts of it he will unquestionably be long referred to as an authority by stranger as well as friend. He dwelt in an atmosphere essentially unfavorable to the spirit which directed his work, for nowhere in the world can there be found so high a degree of general civilization conjoined with so small a degree of general appreciation of pure science as in America. This may be said with full recognition of the abundant rewards here accorded to science successfully applied in industrial fields, and of the rich endowments given by wealthy individuals to some of our educational institutions. But the man who advances theoretical science in America receives not a tithe of the recognition given to the inventor who puts on the market a merchantable device which pleases the multitude. Prof. Mayer would have done his scientific work to better advantage in France and Germany. But be this as it may, we who knew him in his work must now know him only in memory. To have had him as a co-worker and friend is now a sad pleasure, and one that nothing can take away.

[Continued from SUPPLEMENT, No. 1133, page 18109.]

IMPROVIDENT CIVILIZATION.*

A PLEA FOR THE APPLICATION OF SCIENTIFIC METHODS TO THE AMELIORATION OF SOCIO-ECONOMIC DEFECTS AND DISORDERS.

By RICHARD T. COLBURN.

II. DECADENCE OF RACES.

THE abstraction of numbers by warfare and the privations of army life, vast as they were, do not account for the decline and degradation of the great empires of the past. Besides, decay seems to overtake the conquering as well as the conquered race; and there are instances where the enslaved have become in turn enslavers. Mere numbers are not strength nor tenacity of nations: witness the Hindoos. The old Greeks were not numerous, but what they lacked in numbers they made up in vigor and sagacity.

What are these other causes of premature decay? In other words, is there a natural term of life for races, as for individuals—a cycle of growth, maturity and senility? Dr. Charles Pearson, in his work on the "Life and Character of Nations," has attempted to answer these questions and, in addition to other minor causes, traces the decline to an inherent difference of stamina or staying power in the ethnic divisions of mankind, corresponding to our present external classification of races by color of skin and hair. The startling conclusion he reaches is that the swarthy or dark-skinned races are destined to outlast, and of course supplant, the lighter-skinned or Aryan group. The evidence is scanty and inconclusive; but it is significant and carries us back directly to the interesting controversy now waging between Prof. Weissman and his critics as to the quality of the germ plasma and its transmission without impairment or improvement, into which we cannot here enter. The rival hypotheses of Galton and Cope deal, however, with problems belonging to the sociologist as well as the zoologist and microscopist.

The doom of the light-skinned races, according to Pearson, is fixed, for it is not to be averted even by admixture. The bearing of purity of race on its persistency is far from being worked out. So far it goes to show the active dominant types are mixed; while the purer races are few, isolated and nearly stationary in civilization. Whether these differences be due to reversion of ancestral types—atavism—or to the greater complexity of organization and nerve strain, is an interesting study which we must ask the biologist and somatologist to elucidate for us.

Just why the builders of Assyrian, Phenician, Nile Valley, Yucatan, Grecian temples, thousands of years ago, have not left their qualities to their descendants, may be due to other causes than the stability of the somatic cell or to intermarriage; for instance, denudation of forests, inroads of infectious or contagious disease, insect pests, errors in diet, the warrior occupation, or a combination of all in greater or lesser degree. The higher types of men seem to have arisen along the broken coast line, or in the moderately elevated regions. The great plains or steppes have not been favorable to density or quality of population or to courage or vitality. The liability to periodical prairie grass or forest fires may have stunted the development of men and animals alike. Meteorological conditions are important to flora and fauna; the annual mean of sunshine, the precipitation of moisture, the range of extreme temperature, and the degree of humidity are factors of survival in the geography of races. The more northerly seem to prevail over those nearer the equator—provided we do not go too far north—due allowance being made for the modifying influence of ocean currents and altitude above sea level, the lines being not exactly isothermal but hygrometric. Singularly enough, there are notable exceptions to this rule. In the dry deserts of Arabia are to be found, among a population of Bedouins, chiefs of noble mien and splendid form, descended apparently without dilution from a remote ancestry. So in Abyssinia, almost a hermit nation, as Slatin Bey tells us, the natives combine great physical endurance and courage, under the most adverse surroundings of plant life and notwithstanding the general prevalence of syphilis, long supposed to be an escutcheon of civilized mixed races, and a very sword of destruction. The example of the Jews so frequently cited in favor of purity of race is important evidence, but complicated with other than ethnic factors, such as the Levitical code of hygiene, the rite of circumcision, the confraternity caused by ostracism, restricted occupations and social temptations, each of which plays a part in the endurance of races.

As a matter of fact, the population of those nations which make enumerations has largely increased since 1815; but this has been made possible by the opening of new sources of food supplies, for which exchanges of manufactures have been given. In spite of the migration of more than twenty millions to distant parts of the world (America chiefly), every considerable area has increased its own numbers; and it is only quite recently that France, the sole territory where emigration is practically nil, or less than the immigration, is found to be stationary or slightly declining. There is a well fonnded suspicion that what is now happening to France will, in due time, happen to the others from the same causes. Is the fate of Rome, Carthage, Venice, Thebes, to be repeated? Macaulay's New Zealander sketching the ruins of London Bridge is prophecy alluring to the historian, but it also finds ready acceptance among social philosophy essayists, who offer, however, the most divergent array † of moving causes, such as the decline of marriage, vaccination, flesh eating, narcotics, condiments, degeneracy, iced drinks, sewerage, irreligion, destruction of caste distinctions, etc.

Unless we assume that there is in each new birth a redemptive power, a dropping of the taints of parentage, the human race ought logically to have come to an end long ago. In some way, as yet obscure to us, in which natural selection plays its part, health must be catching as well as disease; otherwise the major and minor pestilences would have brought a quietus. Phthisis is a comparatively modern disorder. Cancer is another of the internal lesions coming to be known as induced diseases of the blood which may be carried about to all climes and propagated with fatal facility. Whether the special bacillus starts the decay of the lung tissues or follows as a sequence of the decay seems to be still in doubt. Pathologists are just now enamored of the theory of antitoxine inoculation—a sort of tame medical ferret sent in to combat the invading rodent organism. If this is our best hope, the ravages of tuberculous, cancerous and febrile ailments leave civilized races but a short respite.

The researches of Sternberg and Metchnikoff into the function of the leucocytes as guardians of the normal state of arterial currents is more intelligible and logical—if the hypothesis of phagocytosis shall be established—as this leaves the work of eradication of the blood deterioration in the hands of the organism itself, not wholly beyond human control, makes it largely an affair of metabolism of food into living cells with a counterpart activity of the emunctories. The function of the ductless glands in the formation of these blood cells is the corner of histology and pathology now awaiting special researches, and from which we may expect refreshing relief from the antiquated fetish theory of antagonizing drugs.

History concurs with physiology and with statistics in the view that civilization is not favorable to marriage and fecundity, though it may be more propitious for the rearing of offspring. In spite of the surcharge of sex passion which nature has thrust upon men, and the equally enticing wiles and coquetry of women, most of whom must look to marriage as a career, it is more and more of a failure. Polyandry and polygamy are being crowded out by monogamy, but the philosopher is tempted to ask whether monogamic union and the family as we know them are also to disappear; and, if so, what will take their place? Shall it be a return to celibate asceticism or a resort to the state as foster mother?

For some occult reason it is not as easy to be born into the world, now and here, under civilized conditions, as formerly under semi-civilized. The proportion of stillborn may be less in our days than formerly; it probably is, but the infant mortality is greater. The mortality of parturition increases alarmingly, notwithstanding aseptic devices. One may well ask why the parturition of the homo sapiens is attended with so much hazard. Whether the civilized man habitually mates at a later period in life than the savage, after the pelvic bones and ligaments have lost much of their elasticity, or that a larger cerebral development of the modern infant, out of proportion to the bony or muscular framework, renders him less viable; or whether the replacement of the earlier sage femme by an accoucheur with his case of instruments and anæsthetics is more responsible for the increased mortality we leave to gynecologists to decide. The change of both sexes to indoor employment in shops and factories rather than arduous labors out doors accounts for some of the loss. The net result in grandchildren may be the same as for prehistoric man by reason of better care during the period of adolescence.

If our census statistics are trustworthy, prudential as well as physiological causes are at work in the same direction. Families do not arrive so early, nor in such quantity, as in primitive life. The perpetuity of the race is left to the unthinking classes. The aversion to child-bearing crops out (especially in large cities) in various ways. The practice of abortion, very common in Asiatic countries, and suspected to be very prevalent in Europe and America, proceeds, of course, from prudential or economic considerations, fashion, or avoidance of social penalties. We know that the advent of girl children to the Chinese and some other peoples is looked upon as misfortune; as might be expected, fœticide and infanticide are common. Fear of want, love of pleasures and varieties, dread of pain and risk of death, the handicap in matter of house renting, awe of the religious authority—all play their part in this great matter of diminishing population, which has engaged the attention of the French savans and legislators, and the sacerdotal government of Quebec.*

The optimist queries: "Why worry about the extinction of the human race?" which reminds one of the American Plato's reply when told by an Adventist that the end of the world was at hand, viz., that "he could get along very well without it." The question whether perpetuity of race is desirable is equivalent to asking whether anything human is worth preserving. It is answered by science and ethics alike: whatever may be the rights of the individual over his own life, the plain inference from study of nature is that parents exist more for the sake of children than children for parents; life is essentially a sacrifice of the passing for the coming link. The more serious query for us is to know how it may be lengthened, or extinction avoided. Not one of us cares to be of a declining or prematurely dying race.†

* An address before the Section of Social and Economic Science of the American Association for the Advancement of Science, August, 1897. Mr. Colburn is vice-president and chairman of this section.

† Mr. G. A. Read, for instance, finds in the proneness to alcohol and narcotics an artificial ordeal exterminating those least able to carry their load of poison.

It was reserved for Mr. Brooks Adams to discover that the scarcity of the circulating medium (in this case the depreciation of white metal is in mind) was decimating the whole race.

* The birth rate of the New England States ranges it seems between 18 and 22·5 per mille, while that of the far West States is still less, or less than that of France, and, being lower than the death rate, means, unless redressed, ultimate extinction.

† On this very point an interesting and instructive bit of testimony has recently come to hand.

The opportunity of studying the aboriginal life of those interesting islanders in the Pacific Ocean is passing before our anthropologists, and physiologists have extracted the whole lesson for the benefit of learning. The British government recently appointed a commission to examine into the decline of the population of the Feejee Islands. The proceedings, intensely amusing, might have been more instructive had it been composed in part of trained feminine obstetricians. The inquiry disclosed a birth rate surprisingly high, much higher than the average of Europe, and a death rate still higher, and all sorts of reasons were offered to account for it, as it was a concomitant of the coming of the Caucasian race, the onus fell on traders and missionaries. The testimony of an elderly accoucheuse, familiar with both conditions, revealed the fact that the native women had become indifferent to the obliteration of their own people, and this because the joyousness and sans souci had been taken out of their lives; a sense of sin had been introduced, and those Gardens of the Hesperides had

Gratification of the gustatory nerves, located at the back of the tongue (which is not at all identical with the appeasing of hunger), together with the convivial propensity of man, a corollary of his gregariousness, is responsible for a part of his shortened longevity. It has its double aspect of physiological and psychical influence. No people suspect their daily food, or beverage, to be harmful; for the most part they would as soon tolerate criticism of their religion, their patriotism, their wives, as their bill of fare, but each in turn freely expresses his contempt for the table of the others. Is there not some underlying vice in the habitual food of the civilized world, which, of course, includes its preparation? Of the grass seeds which furnish the staple for the bulk of the world, rice constitutes at least half. Christendom prefers the wheat, rye or maize, which we esteem as the superior grain; yet the Chinese and Japanese contrive somehow to nourish stout sinews, though more diminutive bones, and acute brains and courageous hearts out of the blander grain without recourse to much animal food. Their superior recuperative power in hospital against injuries and lesions of disease is notable. The conquering quality of British tribes is believed to be due to the ample ration of beef; of the German to his of beer and sausage; of the Mediterranean littoral, to their free use of wine. To modern science we are indebted for the explanation that the decoction of the coffee berry by the Levantines and of the tea leaf by the Mongols for ages has probably contributed to their survival, by supplying a boiled or fermented liquid, which was doubtless comparatively more free from morbific bacterial organisms than the polluted wells from which the water was drawn, in those densely crowded and ancient abodes. The medical view that life is shortened more by over-eating than by starvation, in its ordinary sense, is confirmed by the chemist's laboratory tests, and by the spectacle of contrasted races. Can we not, while imparting our science, philosophy and literature to the Chinese and Japanese, take a lesson or two from them on diet, and perhaps on clothing and house furnishing also? Their comparative exemption from phthisis, cancer, insanity and neurasthenia (aptly described respectively as atrophy, mutiny, and exhaustion of the cells) alone should put us upon our inquiry.

A leading American physician has said, more or less jocosely, that compared with the present, the coming man will be a big headed, small bodied, puny limbed, bald, toothless, spectacled and toeless creature subsisting on concentrated foods, to which we may add the qualifying remark that he will not keep coming for any long period. The fate of that people where teeth and eyes decay and dentistry and opticians flourish is not at all conjectural. It concerns the student of physiology and sociology alike to ascertain what causes are at work impairing the digestive organs, the teeth and eyes of civilized peoples, and in what respects the as yet uncivilized have a manifest advantage.

Making due allowance for the power of accommodation of the system whereby blood and tissues are made out of so wide a range of food stuffs, the conviction forces itself upon us, seeing the effect of alimentation upon plants and animals, that while the norm may be a shifting one from youth to age, there is a norm, and that deviations from it must tell upon the vigor and endurance of the race. The very general use of salted and smoked meats for example; has not that had much to do with the increase of gouty and rheumatic affections, usually attributed to acid fruits or wines? This practice could easily be dispensed with, by the use of cold storage and desiccation.

Then again, the civilized man, and especially the woman half of him, habitually lives in a warmer, closer atmosphere than the savage. Have not our airtight houses, with their stoves, steam pipes, furnaces and weather strips, contributed not a little to diseases of the respiratory organs? Nay, the presence of a cellar under the dwelling rooms is a suspicious coadjutor. Then there are the germ dust gathering carpets, curtains, portieres, plush furniture—are they not in some degree responsible for the spread of pathogenic bacteria upon tissues already weakened by defective nutrition?

An English physician, lecturing to a recent graduating class, as reported in the Lancet, ironically said, by way of caution against excess of confidence, that "the average life of a fact in physiology is about four years." Intended as a reproach upon the practicing medico for his running after new therapeutic discoveries, it is also an encouragement and a compliment that one error can be run down, and superseded it may be, by another, in so short a space as four years. Alas! it takes a much longer period, on the average, to exterminate some of the so-called facts of social and political science

III. PERNICIOUS COMPETITION.

Prof. Cairnes happily hit off one of the most salient features of the literature of political economy, of the passing generation at least, when he styled it "a more or less handsome apology for the present state of things." One cannot but feel that it has been for the most part a thrashing over of old straw, and even now with enormous output of printed matter, there is very little beyond a rehash of the old controversies about wages, funds, rent, balance of trade, incidence of taxation and so on. Writers divide themselves into three classes, each of them defective without the other two; the historians and academicians who have gone over the writings of their predecessors and who know but little of the business of the world; the statisticians who put faith in their ability to reckon up into tabular form that which is incomputable, as well as that which is, and whose industry is out of all proportion to its value for scientific use; then there are the enthusiasts who are profoundly dissatisfied with the present distribution of wealth or the conditions of industry, and who can propound schemes of reform and then turn the older arguments and figures round as upon a swivel in support of the ideals. Doctrinaires, who for the most part write the treatises and books about finance and trade, know but little of the world about them; while the bankers, arbitrageurs and movers of the world's crops and tonnage are too busy to write about what they understand. The result is the literature of political economy is about one generation behind the practice. Especially is this true of international finance.

The new world, having a virgin territory to occupy and improve, has run in debt to the old somewhat recklessly. The burden of interest and repayment of the capital is irksome. Extension of the debt at low rates is dependent on capacity to pay if demanded. So long as we are handicapped with this mountain of debt, it is in the power of a few foreign holders of our promises or titles to property to bring on a panicky feeling at any time they choose, though fortunately it is not for their interest to do so, but the time may come when it will be. Besides this hampering of debt, there has been an unconscious extravagance, of which we shall have more to say when we speak of the tendency of luxury. In a wholesale way we have been exchanging our liens on and evidences of ownership of lands, timber, railroads, manufactories, mines, breweries and the like for shiploads of merchandise, the bulk of which we should have been the better for not having at all, and nearly all of which we might have made for ourselves. To get square will cost us hard work and self-denial. With the exception of this broad distinction of debtor and creditor nations, and of the latter supplying articles in which there is limited competition, all the world is engaged in a general scramble in which cheapness of production is the goal. The industry of nations has developed into a species of hostile contest, not quite so hazardous as actual warfare, but demoralizing and exhausting in a less degree only. It is as if all marches were required to be forced marches; and all business must be conducted on the brink of the precipice of bankruptcy. It was always so within the confines of a given territory; but the substitution of steam for animal power and of dexterous machinery for handicraft has not only intensified the competition within the old boundaries, but has also set the maritime nations to trying to undersell each other. In this contest for cheapness, standards of living, hours of labor, habits of frugality, depth of purse, vigor of body and acuteness of mind all have their part to play, and the efficiency and economy of government, stability of institutions, probity of character are also pitted against each other. Individually and collectively, an ordeal, growing more and more severe, confronts all trade, agriculture and manufactures. When the five hundred millions of Eastern Asia shall have grasped our mechanical inventions, it is idle to suppose the occidental standard of living can be maintained if the régime of unrestrained competition is to continue.

This is the crux of the labor problem, and also in large part of the commercial and financial problem. To the older writers aiming their arguments against the arbitrary and often absurd restraints of trade by statute, it seemed as if perfect freedom of trade was an ideal state of things, to usher in a millennium. The question has become too broad for local statutes. Freedom of trade breeds extravagance, improvidence, overproduction, followed by panic, depression, enforced idleness, discontent, and so on in recurring cycles. The struggle is too keen; it is the cosmic struggle for existence intensified, socially wasteful and destructive. Too many men are in trade; too many trying to "live on their wits," with the result that the peasantry of all nations are being worked too hard and robbed of their share of the gross product.

Less than half the population of Christendom is at work, half of those in agriculture, fifteen per cent. in professions and public service, while ten per cent. are in trade and transportation. Left to itself, we may be sure that by natural selection the weaker in trade will be forced to the wall and the few fittest will survive, but the competition will not stop; that must go on unless some general corrective is discovered. The tendency in domestic trade may be found in the mammoth department stores, which are surely crowding out their smaller competitors, and this results in such dislocation of trade from its usual channels as to engage the attention of legislatures and turn elections. It is obviously the fact that in nearly every city or town there are about five times as many merchants in a given line of business as are necessary, each with its corps of clerks, bookkeepers, delivery wagons, etc. If the saving of a concentration is shared with the customers, as it certainly is in practice, the community of buyers will have no reason to complain, but it is otherwise with the producers and manufacturers, who must submit to the prices dictated by the big concerns, who are frequently able to take the whole product or refuse any. The power of concentrated capital and marshaling of labor, which has been going on in mechanical occupations, has now spread into trade, shipping, finance and even into educational pursuits.

The smaller rivals are seeking shelter with the larger ones by absorption or alliance to escape a worse fate, as we noted in the case of political aggregations. This has led to consolidations and leagues under the name of trusts or other fiduciary contrivances. Railroads cannot escape from being dragged into this pernicious rivalry; they are under control of their patrons rather than of their stockholders. The legislatures, sustained by the highest courts, say they shall not combine "in restraint of trade;" though they are reluctant to cut each other's throats in competition, they are compelled to keep in the game at the same rapid pace as their customers. Regimentation and coercion in labor, hardly less intolerable than regimentation and obedience in militarism, are threatened unless some remedy can be devised. Laissez faire points toward a cruel and despotic struggle which is discouraging in the extreme; nor is there in the province of legislation apparently any adequate relief.

The step from a status of slavery to that of serfdom with a claim on the land for subsistence was important; the evolution from that to voluntary contract was equally so, and no people holding to either of the former systems of labor can hope to contend against the latter. But the régime of free contract is hardly a finality. The rankest injustice is perpetrated under its forms all over the world where proprietary rights are acknowledged. It is, of course, far better to require the consent of laborer and employer, but with this con sent great wrongs are possible—are, indeed, common. This is a very grave question in social science, "how to put a curb on astuteness," as a magazine writer has styled it; how to shield the weaklings and credulous from spoliation by the crafty and unscrupulous. How shall the ignorant and confiding part of the population be safeguarded against overreaching, temptations, wiles and wares set for them and for each other without opening the door to still greater evils? These lures are of all sorts and degrees, from the knave who offers to sell counterfeit money or lotion to beautify the complexion to the banks, insurance and trust companies of many kinds; nor are the learned professions above setting traps for the unwary or of suborning the press into becoming accessories. Look at the enormous outlays for advertising proprietary medicines, which debauch and befog the public conscience, if they do not injure the public health.*

It is not easy to suggest a rectification of the evils of unbridled competition, especially where statutory restraint is either aggravative or impotent. With some hesitation I venture to point out some of the underlying causes of our trouble.

First, let me ask, "Why do men engage in and remain in trade, or enter upon any of the professions?" The usual answer is, "To earn a livelihood;" but this is not all. In civilization certainly there is the further motive of a desire to succeed, to become a master in the craft if possible, and whether or no, to amass some surplus of possessions as a provision for old age, to win society prizes, to dower daughters, start sons in business, perhaps found a house, endow a charity, build a monument, or leave a fortune, all of which motives are of the mind. We each of us see, or think we see, the wisdom or necessity for any one or more of these aims and purposes in life. Men and women are the slaves of ideas, and words stamp ideas so firmly on the average mind that they are with difficulty dislodged. What different ideas are conveyed by the words "success in life"! Not one in a thousand analyzes the thought to see its relativity or instability. If there were no need for a provision for old age, or for charity bequests, the extra industry would be needless too. If there were not the ambition to win, to excel, to outrun or outgather, the tremendous exertion of the rivalry would be stupid. Partial attempts are made to do away with the necessity for individual provision for the infirmities of old age by providing retiring pensions for the army, and in some countries for civil officers also. For those not directly in the service of the state, poorhouses (which are too often poor homes) are established by law; and some states now propose to aid by labor pensions also. These arrangements are the just and necessary sequel of a state of things where human life and vigor are sacrificed wholesale in the strife for cheap production.†

Second.—The eradication of the vanity of emulation, the desire for distinction, may be more difficult, but something might be effected in that direction. Suppose, for the occasion, that there were no prizes to run for, there would be less racing; I mean not material trophies, but the distinctions and adulations of winning in any contest, athletic, professional or social. If, by some happy contrivance, as much pains were taken to encourage confraternity and equality of estimation as is now taken to encourage leadership, and dissimilarity of estimation, would not much of the social strife and worry disappear? Within the family such inequalities are generally frowned upon. Can we not extend the ethics of the family beyond its pale to the whole social organism? The idolizing tendency of human nature is one not to be proud of or stimulated, but rather to be repressed. Why would it not be well to commence with infancy, in school or business, and abolish all prizes, honors and bribes of every sort for simple good conduct, or for doing one's best? Where there are winners there must also be losers; and for the latter there is very little regard outside the family, which discouragement is of itself conducive to further failure, bitterness, malice or suicide. The office should seek the man rather than go to the persistent intriguer or shameless "hustler." Aside from the fostering of an unwholesome sense of superiority, does not the whole practice of merit marks and competitive examinations of our schools and colleges work badly, in favor of a certain superficial readiness of mind which will have advantage enough over a less precocious maturity without conventional badges? The honors and emoluments of public and private station go together, a duplication of pay. It is one of the most somber traits of the older civilizations surviving in great vigor, the

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been turned into vales of tears and disciplinary plantations, workshops and hospitals for which the hopes of a celestial reward are deemed no compensation. The same lesson is to be drawn from the Hawaiian group; the advent of the superior race is fatal not merely to the life of the inferior race, but the sad grind of money getting, the worry of competition, and modern fashions is fatal to contentment.

Is it not even so, in a degree, with our competitive civilization and religious creeds in Christendom itself, and in Buddhist lands? Have they not cast an artificial gloom over lives that would be full enough of sadness without them? What a pity that some effort has not been made to discover the source of that uncomplaining stolidity of the redskin papoose as I have often seen it, carried on the back of its mother; or of the general glee and absence of painful cries in the Japanese babies as compared with those of the western lands.

* H. J. Davenport, in his recently published "Outlines of Economic Theory," tersely sums up the evils of competition in trade:

"The stimulus of private interest works out in a vast amount of crime and disorder which necessitates, in policemen, courts, juries, sheriffs and lawyers, the expenditure of social energies. Likewise in purely private affairs the expense of preventive methods against ill faith and dishonesty is a weighty matter. Outlays of this sort would be relatively small in the collectivist system. There are large wastes of energy in competitive attempts to give to cheapness the outside gloss of value. Shoddy in cloth, paper insoles in shoes, clay in soap, marl in sugar, not only waste the energy of putting them in, but largely destroy the usefulness of the honest product. Socially speaking, all this cheapness is excessively dear.

"There is a similar compound of waste in the enormous outlay for newspaper puffing and lying. The entire system, also, of marketing through agents and commercial travelers has in it large elements of waste. The excessive multiplication of middlemen generally falls under the same head.

"The present system is also responsible for hordes of human beings living by their wits or their worthlessness—social make-nothings, paupers, vagabonds, speculators of useless types, prostitutes. Parallel with these are the respectable do-nothings, the leisure rich, the inheritors of wealth, the coupon cutters. Within this class of respectable make-nothings must be reckoned also the valets and waiting maids, the outriders, hostlers, servants and flunkies whose energies never work out in any utility, for which the world has any real need. And in a background of misery stand the unemployed, with whom, as misery, we are not at present concerned, but only as waste. Never an inconsiderable class, they swell in times of depression to an enormous army."

"Fashion demoralizes industry and fosters starvation. Warehouses are filled with commodities to supply a demand that has vanished or to forestall a demand which never appears. Disaster and ruin result. A novelty strikes the popular fancy; there follow immense profits, intense production, multiplied factories, prosperous allied industries, growing cities, inflocking laborers, investment, speculation. Fashion grows cold when the commodity becomes cheap and plenty; then failure, closed factories, canceled capital, collapsed boom, idleness, hunger and riot. Almost all industrial centers know something of this experience. All over the world there are Nottinghams regretting a banished lace industry. The foe of industrial peace is ebb and flow, change and uncertainty. Fashion in commodities is parent to business gambling, great fortunes, great losses, feverish activity, feverish lassitude, fluctuation and bankruptcy." (Pp. 305 et seq.)

† Mr. Plimsoll convinced his government that near 2,000 sailors' lives were recklessly lost yearly through overloading. We may note in passing that the need of such provision is seldom found among proprietors of the soil, small or large; the farm is the savings bank and, in the hands of a practical farmer, a very good one. Neither is the working farmer often spurred by the ambition or vanity "to cut a figure" or win some distinction in the society ranks. If himself or family takes a premium at the county fair, it is as a sort of contribution to the common enjoyment, and not as a distinction of social caste, nor does he require the relief of pauper acts in old age.

readiness to fall into line obediently behind the nominal leader. When physical prowess was the surest road to distinction, the sway of one man power was a necessity. In these days of deliberative assemblies of quasi-equals it is a vestige of former subservience. Perfect equality of mind, or stature, we shall not have; but there is no justification for putting the tall man on stilts and lopping off the shorter ones. This is just what our present civilization is blamable for doing. The winner, if only by a nose length, or by a scratch, is elevated out of all proportion to his excellence. If we must "play pretend" at all, why not minimize the differences between coadjutors, rather than exaggerate them? Some may declare that, all men not being alike, they cannot be treated alike. Certainly not, but we ought not to magnify or multiply the rewards for the superiority which, if it does exist, nature is sufficiently discriminative without the help of social man.

Third.—Corollary to the provision for maintenance in old age or disability is the necessity for some system of more constant and steady employment prior to decrepitude. At the best of times fully ten per cent. of able-bodied laborers, mechanical or factory hands, are living in enforced idleness, and in times of depression the percentage is very much higher. The difficulty here, too, is in part psychical. It is not enough that the laborer wanting work and the employer wanting work done succeed in finding each other; the latter must be satisfied not only as to the wage he can pay out, but also as to the character of the proposing laborer; he does not want to introduce discontent or disorder among his men. This trust or confidence is almost impossible in an idle population drifting across a continent. Without going so far as to affirm the right of the willing laborer, even if he have a family depending on his exertions, to employment by the state; still the community has him and his family to support in some way; why not do so in a systematic and economical way? It may be said that it would discourage saving habits, but the present plan does worse; it begets a lack of sympathy. If every county in each State (it would operate badly to have it in some and not in others adjacent) were to lay out in advance some useful public work, sufficient to employ the quota of discharged laborers, at a bare living wage, to prevent tumult and pillage, credit being resorted to if necessary, the positive benefits might not be so great, but the unseen damage might be averted. Central Park, in New York City, owes its existence to an impromptu politic stratagem of this sort; and there is not a city or county that might not resort to similar works of transport, embellishment or sanitary aids, greatly to its advantage, and thus mitigate the severity of panic waves.

(To be continued.)

DENDROBIUM VICTORIA REGINA, LOHER.

OUR illustration gives a representation of this pretty species. The plants were sent to Messrs. Protheroe & Morris, who offered them on Friday, June 18; and, therefore, the proof of the correctness of the description, which purchasers look so anxiously for in the matter of a "blue orchid," was not long delayed, for specimens of it have flowered in several collections and have generally been considered satisfactory. The specimens vary somewhat, but all bear white flowers colored on the outer halves of the segments with shades of blue. It is stated to be a native of the Philippines, growing at an altitude of 6,000 feet. The plant from which our illustration was taken was exhibited by Thomas Statter, Esq., Stand Hall, Whitefield, Manchester (gr., Mr. R. Johnson), at the meeting of the Royal Horticultural Society on August 10, when it was given an award of merit.—The Gardeners' Chronicle.

AGRICULTURAL.

ALL the counties of the State of Ohio are now organized with from one to six farmers' institutes in each county, and from reports of the meetings of these institutes, from November 30, 1896, to February 27, 1897, as made to the Ohio State Board of Agriculture, the board publishes an interesting volume of lectures and papers thought to be of value to farmers, stock breeders and horticulturists, from which we make a few extracts. It may be interesting to note that the attendance at these institute meetings varied from about 280 to 800, presumably mostly farmers, at each meeting, the total attendance at the series being given as 85,469.

CONDITIONS OF PLANT GROWTH.

By S. H. HURST, Chillicothe, O.

Next to fertility and water in the soil, mellowness or refinement is a factor in the growth of crops, and this condition of the soil is almost wholly under the control of the farmer. Barnyard manure or decomposed vegetable matter of any kind is promotive of mellowness, and a degree of moisture is necessary for the most inviting plant bed. But refinement by cultivation is generally an absolute necessity. Years ago it was common to see corn planted or wheat sown in cloddy ground where a half crop seemed an impossibility. But improved methods have brought the clod crusher, the smoothing harrow, the disk harrow and drag into general use, and now no intelligent farmer thinks of planting or drilling for any crop until his soil is in good condition. A good seed bed is the first consideration. We refine and mellow the ground before planting, to prepare a mellow seed bed, and we cultivate and refine the soil as the plant develops to maintain a mellow root bed. In the work of cultivation it is an error to say or to suppose that we cultivate the crops. We do not, primarily. We cultivate the soil to make it mellow and fine, so that it will hold the fertilized moisture, and thus invite and promote root growth and root feeding. We certainly do not want to cultivate a plant simply to lacerate or destroy or shorten its roots, thus depriving it of the power to feed on the vegetable nutrition or fertility around it, and with our modern ideas of level culture we do not plow to "hill up" the plants. The two legitimate offices of cultivation in crop growing are the refinement and mellowing of the soil and the destruction of the weeds. After corn or potatoes are planted, it can scarcely be desirable to plow at all to any depth, if the soil between the two rows is quite mellow, so that the roots and rootlets can push out in every direction, and drink in the fertile water. But if, after planting, the ground is "packed" by heavy rains, it will doubtless be well to plow once with a set of long narrow shovels to mellow up the land again, lest in its compacted condition, dried and "baked," as we say, it would be almost impervious to root growth. But if the middle is continuously mellow, then only the surface should be stirred to a depth of one to two inches, and this by a fine short-toothed harrow or by a sharp fluke harrow, or by a system of sharp steel knives, which, attached to a harrow frame, cut off every starting weed just below the surface of the ground. This shallow cultivation of the ground destroys all the weeds and makes a sort of mellow mulch which lies like a blanket on top of the ground, breaking up the capillary power of the soil, and holding the moisture that is stored in the root bed beneath this blanket so that it may constantly feed the growing plants. This new theory and practice of surface cultivation must commend itself to the practical farmer, since it checks evaporation, catches the rainfall and transmits it to the subsoil and destroys the weeds just as they germinate, thus leaving the whole wealth of fertility in the soil, and leaving also the entire equipment of plant roots unbroken, that they may feed upon this fertility and bring the crop to its fullest and largest perfection.

THE SILO.

By F. A. DERTHICK, Mantua, O.

The introduction of the silo as a factor in modern agriculture has not met with that general favor which its merits demand, and, although an increasing number of dairymen and stock raisers are availing themselves of the advantage of ensilage, the majority is still very large who cling to the older system of dry fodder. This is in part due to the extravagant claims made for ensilage by the early pioneers in the new departure. These enthusiasts insisted that, by some unknown and mysterious process taking place in the silo, the food value of the fodder was increased. Later scientific investigations exploded this fallacy, and thus suspicion was aroused against the system.

The advantages of ensilage have been found to lie in another direction, and that, instead of there being any addition to the food value, there is an actual loss brought about by the conversion of at least a part of the starch and sugar into various acids (lactic or acetic, or both). The Wisconsin Experiment Station after a study extending through a series of years now declares that there is a loss in the nutritive food value of 16 per cent. in both dry matter and protein as against a loss of 24 per cent. on the field dried fodder. It is evident that this slight difference will not in itself justify the outlay necessary for the construction of a silo.

The advantages of the silo may be summed up as follows: Silage furnishes a succulent summer food in winter, thus making it possible and profitable to produce milk during that season of the year when the market is comparatively bare of milk, cheese and butter. This feature alone will prove of incalculable benefit to the dairyman, as it will give a more uniform price for dairy products by withdrawing a part of the surplus of milk from the summer months. Again, the value of silage is supported by economic principles, as the complex changes going on in the silo render the food more digestible and easily assimilated; especially is this true in the case of corn silage. The effect of the moisture and heat of the silo is much like the cooking of food in so far as putting it in the very best condition to be digested. Many insist that the digestive organs of the animal are thus relieved to a greater degree than when the grain is taken to the mill and ground. Silage is also more palatable than dry food and is received with greater avidity by all kinds of stock accustomed to its use. The moist and softened condition of the coarser portions of the stalk, hitherto rejected in great measure, are thus laid under contribution to the food supply of the farm. This is in line with the findings of our scientific friends who claim that the lower portion of the stalk has as great feeding value as the corn itself.

It is not claimed that silage is a properly balanced ration, but it should be supplemented by some food richer in protein. Various tables are given by scientific men as constituting a formula in which the necessary constituents of a nutritive food ration are present. From a large number of inquiries, as well as from observation of the most successful dairymen, the following is suggested as a day's ration: Ensilage, 45 pounds; clover hay, 8 pounds; bran, 5 pounds; oil meal, 1 pound. Total, 59 pounds.

This ration can be furnished at an average of ten cents. There may be those who c.. figure the cost of the cow's daily keep on dry fodder at as low a point, but it will not be admittted that an equal flow of milk will result or that the animal will be in as good condition. If the above statements be true, they become very suggestive along economic lines. In these days of close competition and struggle to live, it becomes necessary to accomplish the greatest possible results from a given area of land.

A very successful siloist in Erie County gives the cost, including construction of silo, at $1.25 per ton. The silo he builds in the following manner: The studding are two by six, placed about twenty inches apart near the bottom and increasing the distance as the top is approached. These are securely fastened at the corners. Lining is composed of straight-edged boards, one by six, double thickness and breaking joints. Between the two linings is placed thick paper coated with tar. It is further secured by placing a strong beveled piece of timber in each corner, securely fastened. The bottom can be prepared by cementing, or if of stiff clay, used without.

The first silos erected were for the most part of stone or brick, and when stone is at hand it is a question whether such are not cheaper in the end, as they are practically indestructible, not being likely to spread with the pressure or be affected by the acid of the silage.

Numerous attempts have been made to create a prejudice against the silo by charging tainted milk from cows where silage was fed. This charge has never been sustained where the silage was bright and wholesome and fed in moderation. Many of our most fastidious consumers express their preference for silage milk.

A variety of green crops may be used as silage; clover, millet and the soja bean are said to give satisfactory results. It is to corn, however, that we must look for ideal silage. The leaming and mammoth ensilage are more often used than any other varieties. The pioneers made the mistake of cutting the corn too immature, thus missing the best results. The practice now is to cut when the kernel is dented and glazed, yet before fully ripe. In filling the silo, great care should be taken to pack every part of it closely. The corners should receive especial attention. The secret of good silage, like that of canned fruit, is in making it air-tight. The silo should be of such size that one day's feed will require at least two inches from the entire surface of the silo. Shallow silos are to be avoided, as the greater the depth is, the more pressure—a condition which is in every way desirable.

DENDROBIUM VICTORIA REGINA—FLOWERS SLATY-BLUE, WITH WHITE CENTER.

SOME ANATOMICAL PECULIARITIES OF THE HORSE.

By S. R. HOWARD, V.S., Hillsboro, O.

Microscopically considered, the structure and development of the bones of the horse are identical with those of man. His ribs number eighteen on each side, although occasionally he has more. I remember having seen a mule that had thirty-eight well developed ribs, nineteen on each side. The number of molar teeth is given as twenty-four, but I have seen twenty-eight well developed, perfect grinders doing duty. The skull bones, excluding the teeth and bones of the ear, are thirty-eight in number. The bones of a colt's head at foaling time are disarticulated. These, of course, become united in the adult. The skull of man and the skull of the horse are composed of exactly the same number of bones, having the same general arrangement and relation to each other—not only the individual bones, but the very ridges and surfaces for the attachment of muscles, and every hole for the passage of artery or nerve, seen in one can be traced in the other. We find in the adult male horse, midway between the grinders and the incisors, the four canine teeth. Occasionally they are seen well developed in the mare, but usually in her they are rudimentary, are often shed and never replaced. All mares, however, have the germs of them in the chambers of the jaws, and they appear in the majority of old mares. Some authorities claim they have known of these canine teeth in the male to be shed and replaced, but as a rule these teeth appear only in the male horse and are permanent from the time of their first appearance. While these teeth distinguish the sex, their loss would not be felt on that account. If Darwin is correct, these tusks are in the course of ultimate extinction. There is more or less mystery about these tusks, yet they are important factors in the consideration of the problem of the evolution of the horse as well as of other animals. Perhaps in the long ago these teeth served him as weapons of offense and defense.

THE ORANGE THEATER.

Apropos of the representation of Antigone and the Eumenides recently given at the theater of Orange, a few words concerning ancient theaters, and particularly the one just mentioned, will, perhaps, not be out of place.

Generally speaking, an ancient theater, Greek or Roman, comprised two essential parts: an elongated rectangle designed for the actors and a semicircumference adjoining the longest side of the rectangle and designed for the public.

The long internal side of the rectangle formed the façade. In the Orange Theater this façade was preceded by a portico that is now destroyed, but which doubtless served as a promenade for the spectators and a shelter for the actors. The rectangle itself was divided into two parts. One of these, the proscenium, an elevated platform, extended from the tiers of seats set apart for the spectators as far as to the wall of the stage. Here stood the actors, the choruses and the flute players.

In the rear extended the postscenium, containing the side scenes and the actors' rooms. The stage was provided with three doors that permitted of passing from the proscenium into the postscenium, one of them (the royal door) being in the center and the two others at the sides. In front of the rectangle reserved for the actors unrolled the curtain, or aulaeum, which, instead of rising, as with us, descended at the beginning of representations.

The semicircle set apart for the public was called the cavea, and comprised two parts—at the periphery several tiers of seats and in the center a level part called the orchestra. The seats, to which access was obtained through arched corridors, were reserved for the public at large. Sometimes corporations or private individuals had their names engraved at the place that they occupied, just as is now done with a churchwarden's pew. One tier found in place in the Orange Theater bears the inscription EQ. G. III, that is to say, Equitum gradus tres, "three rows of knights."

The orchestra was set apart for people of eminence, the public authorities, and the Roman praetor, who occupied the center, seated upon his tribunal.

It is from such general data, obtained especially from Vitruvius and Pausanias, and from a thorough study of the ruins of ancient theaters and particularly the one under consideration, that Auguste Caristie, the eminent architect, has been able to restore the Orange Theater herewith represented.

The southern end of this theater is contiguous to the mountain. The structure is 77 meters in depth. The external façade forms a parallelogram 103 meters in length by 37 in height. On the ground floor this façade presents arcades of Tuscan order. On the first story there is a line of blind arcades, and above there is a solid wall that carries two rows of corbels designed to support the masts of the velarium, that is to say of the immense tent that protected the cavea. The Caristie restoration gives us a very accurate idea of this part of the theater. It comprised three tiers of seats separated by circular landings that served as passageways. Above the third rose a portico that was doubtless set apart for slaves and that crowned these tiers of seats. Between the orchestra and the proscenium extended a large passage parallel with the stage.

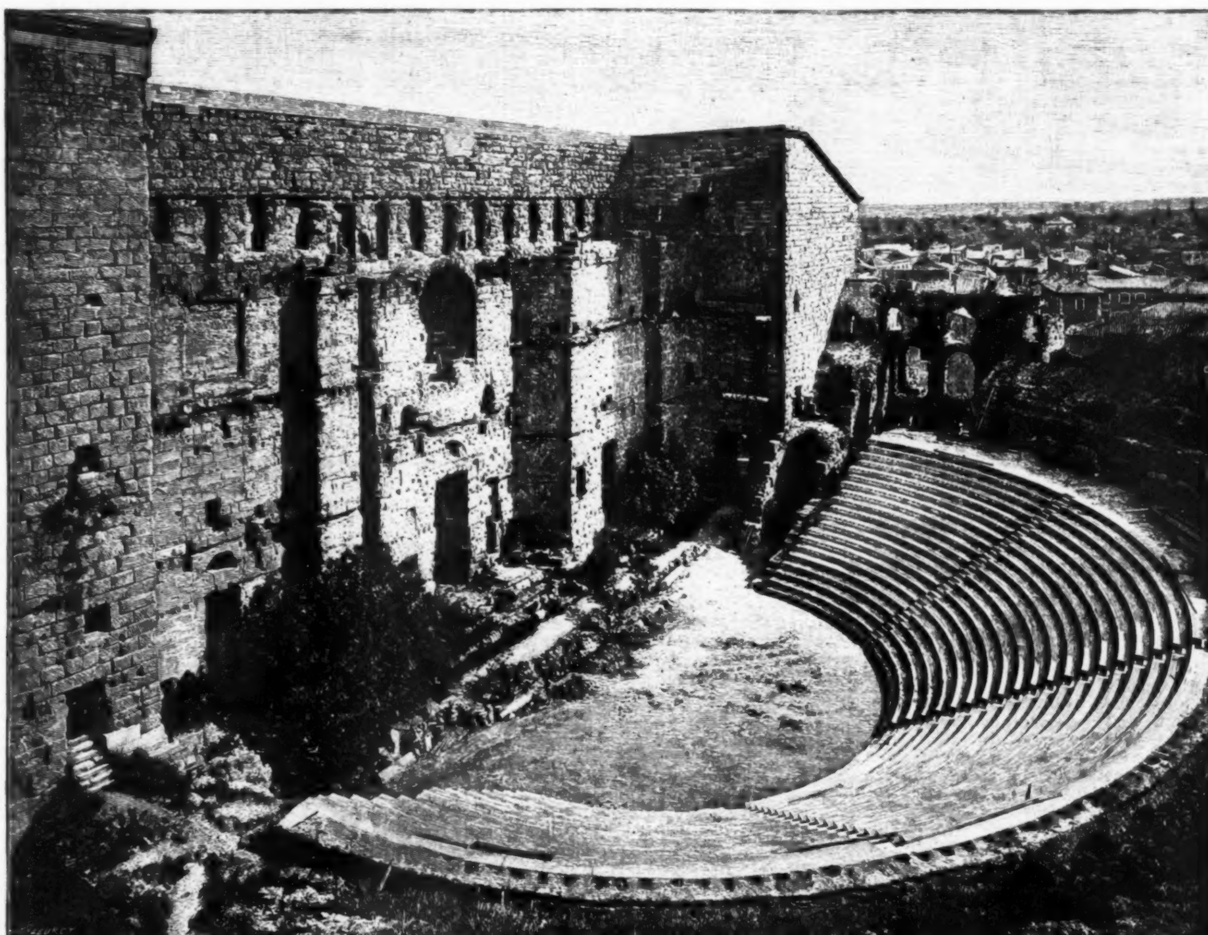
The first fifteen rows of seats ended at a wall with projections; upon the first row of which were seated sphinxes, of which fragments have been found. The orchestra was doubtless richly paved. The stage was sumptuously decorated. The central part, the aula regia, must, according to Vitruvius, have given the idea of a palace. In fact, at Orange, marble columns, statues, sculptures and mosaics were used in profusion. In the center of this internal façade, says M. Revoil, in a very interesting lecture, arises a two story motif, forming on the ground floor the aula regia, a large central door surrounded by columns with niches between. On the first story there was the same arrangement for surrounding the large niche in which was enthroned Marcus Aurelius, under whose reign this theater was probably constructed. To the right and left of this central motif extends a three story architectural decoration formed of three superposed Corinthian orders. This decoration is found again upon the sides of the two foreparts of the proscenium, and, on the ground floor, frames the lateral doors on the first and second stories and mosaic medallions over these doors. Friezes enriched with foliage, bass reliefs representing combats of centaurs, eagles, and various attributes added to the richness of the orders of architecture. The stage was protected by a vast sloping ceiling with gilded coppers, and the cavea by an immense purple curtain.

Such was doubtless the magnificent arrangement of the Orange Theater, when, in the second or third century of the Christian era, seven thousand spectators, clad in robes of dazzling colors, applauded the dramas of Sophocles, the comedies of Caecilius or the mimes of Laberius.

Since those fine days the Orange Theater has undergone many vicissitudes. The barbarians in the first place and the Calvinists in the second destroyed or damaged the Roman antiquities. Maurice of Nassau, who was as great a vandal as they, had a fortress constructed in 1622 from materials taken from the arch of triumph and the Orange Theater. A portion of the edifice was even inhabited by the princes of Orange and afterward converted into a prison. The principality of Orange was united in 1660 on French territory. In 1673 M. de Grignan, the son-in-law of Mme. de Sévigné, and then Lieutenant-General of Provence, had the castle of Maurice of Nassau razed. The theater, which served as an outer bastion, was then disengaged, and when Louis XIV came to visit the city he declared that the immense façade of the theater was the finest wall within his kingdom. In fact, it produces a feeling of surprise and admiration. As Mérimée well says, "For the principal elevation, the imposing effect of masses has been sought, and not a delicacy and exactness of details. Grandeur requires no ornaments."

Under the Revolution it was proposed to convert the stage into a vast dungeon, and Millin, the antiquary, was justly indignant at it. The government of the Restoration finally occupied itself with the ruins of Orange, and as long ago as 1824 Auguste Caristie was commissioned to ascertain the state of the theater, and after this restorations were carried on without any break. Constructions covered the whole interior of the edifice and adjoined the exterior; and the occupants had everywhere sapped the walls in order to enlarge the spaces that they had usurped. In certain places the walls had been pierced, and in others their thickness had been diminished by two-thirds. In the presence of the exigencies of these singular proprietors, it required a law to free the theater from these rats and ravens that had taken possession of it. Caristie's excavations gradually brought the stage and orchestra to light and permitted of the discovery of a large number of fragments. It may be said that he truly rediscovered the Orange Theater. So it is with complete justice that his bust was inaugurated here at the last fêtes.

Other architects have since continued his labors. M. Daumet has restored the cornice of the façade, which was crumbling away, and M. Formigé has occupied himself with the cavea. He has closed up the two apertures that existed to the right and left between the stage and the hall and which left too free a passage for the wind, and has also restored the tiers of seats. The first story, which comprises twenty rows of the latter, has been almost entirely rebuilt. The courses that support the second story are in way of repair. It was but natural that, in measure as the theater was repairing, the idea should occur to place it in a state to be used again for the purposes for which it was primarily designed. As long ago as 1840, M. Ferdinand Michel, a distinguished writer, thought of this, and tells us that at this period he often went to visit it. The keeper of the theater, who was a good declaimer, offered from the stage dramatic tirades that allowed him to judge of the admirable effects of the voice from every part of the auditorium. Gradually M. Michel began to dream but one dream, and that was of giving a representation upon this wonderful stage. This dream was not realized till thirty years later, on the 21st of August, 1869, when he caused "Joseph" (of Méhul) to be represented, along with a piece that he wrote for the occasion: "The Triumphers." In 1874, "Norma," "The Chalet" and "Galatea" were played, and in 1886, M. Mouzin had his "Emperor of Arles" represented twice in succession. It was then that were organized the admirable representations of the month of August of 1888. Boudouresque sang the "Moses" of Rossini, and Mounet-Sully played the "Œdipus Tyrannus" of Sophocles, amid the inexpressible emotion of ten thousand spectators. The magnificent representations that have just taken place, the éclat of which was enhanced by the presence of the President of the republic, have made definitely of the theater a center of artistic and literary pilgrimages—a Bayreuth at once ancient and French.—Le Magasin Pittoresque.



VIEW OF THE ROMAN THEATER AT ORANGE.

The Russian Ministry of Finances has recently issued a report on the production of platinum in Russia, according to which that country stands first in the world for this production, forty times the quantity produced by all other countries together being obtained there. In the year 1880 the quantity produced amounted to 2,946 kg.; in 1895 it reached 4,413 kg. The production had gone on increasing up to the last year, when it diminished on account of the wet weather in summer. This rare metal is found exclusively in the southern Ural. The manner of its being worked up is unknown in Russia; this is done in Germany, to which country the platinum is exported in a crude state. Whatever Russia requires of worked-up platinum it has to buy back from Germany. Of late years the price of this article has run very high; at present it is 900 marks (about £45) for 1 kg. of crude platinum in Russia. On mining for the platinum, the still rarer metal iridium is also found, but only in very small quantities. Last year the total quantity of iridium obtained did not amount to more than 4·1 kg., and this was only slightly exceeded in 1894.

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.*

By LELAND O. HOWARD, Ph.D.

AMONG the many influences which during the last century or two have been affecting that unstable condition of life which is expressed in the words "the geographical distribution of animals and plants," none has approached in potency the agency of man exerted both purposely and unwittingly or accidentally.

Natural spread was for centuries the rule. Species dispersed under natural conditions along the line of least resistance. Winged animals and seeds were spread by flight and by the agency of winds, and at their stopping places thrived or did not thrive, according as conditions were suitable or not suitable. Aquatic animals and plants and small land animals and plants were distributed by the action of rivers and streams and by the ocean itself. Wonderful migrations have occurred, commonly with birds, more rarely with other animals; ice floes and driftwood have carried animals and plants far from their original habitats and even volcanic action has taken part in the dispersal of species. Smaller animals, especially mollusks and insects, and the seeds of plants have been carried many hundreds of miles by birds and lesser distances by mammals.

With the improvement of commercial intercourse between nations by land and by sea another factor became more and more prominent, until in the present period of the world's history the agency of man in the spread of species, taking all plant and animal life into consideration, has become the predominating one. Potentially cosmopolitan forms, possibly even insular indigenes, have by this important agency become dispersed over nearly all of the civilized parts of the globe, while thousands of other species have been carried thousands of miles from their native homes and have established themselves and flourished, often with a new vigor, in a new soil and with a novel environment.

It is obvious that this agency is readily separable into two divisions: a, intentional; b, accidental.

a. Intentional Importations.—Since early times strange plants and animals have been carried home by travelers. Conquering armies have brought back with the spoils of conquest new and interesting creatures and useful and strange plants. With the discovery of America and with the era of circumnavigation of the globe, such introductions into Europe of curious and useful species, plants in particular, increased many fold, while with the colonization of America and other new regions by Europeans there were many intentional return introductions of old world species conducive to the welfare or pleasure of the colonists. Activity in this direction has been increasing and increasing. Public botanical gardens and many wealthy individuals in all quarters of the globe have hardly left a stone unturned in their efforts to introduce and acclimatize new plants, particularly those of economic importance and æsthetic quality, not failing occasionally, it must parenthetically be said, to establish some noxious weed or some especially injurious insect; while it is safe to say that probably the majority of the desirable plants of Europe which will grow in the United States have already been introduced, and that there has been an almost corresponding degree of activity in the introduction of desirable plants from the United States into Europe. In all this host of valuable introductions there have been comparatively few which have turned out badly, aside from failures of establishment. The wild garlic (Allium vineale), that ubiquitous plant which gives its taste to milk, butter, and even to beef during the spring and summer months in many of our States, is said to have been intentionally introduced by the early residents of Germantown, Pennsylvania. The water hyacinth (Piaropus crassipes), originally grown for ornament in a pond near Palatka, Florida, escaped into the Saint John's River about 1890, and has multiplied to such an extent as to seriously retard navigation and to necessitate government investigation. The distribution of the orange hawk weed (Hieracium aurantiacum) a dangerous species which has ruined hundreds of acres of pasture land in New York of recent years, was originally aided by a florist as a hardy ornamental plant. The European woad-waxen (Genista tinctorium) was early introduced at Salem, Mass., in fact about thirty years after the settlement of the colony. It has apparently not been used as a dye plant, but for garden and ornamental purposes only. During the last few years it has become a noxious weed throughout Essex and the adjoining counties. Standing on a rock at Swampscott on July 9 last, the writer was able to see that the country for miles around was colored a bright yellow with enormous masses of this plant. Similar instances are fortunately rare and the majority of our noxious weeds have been accidental introductions.

Intentional introductions of animals, however, have by no means resulted as advantageously as intentional introductions of plants, with the exception of the truly domesticated species, such as the horse, ass, cow, sheep, pig, dog, cat, poultry, honey bee and silkworm of commerce. Even with such species, the grazing ranges of Australia have been overrun by wild horses to such an extent that paid hunters shoot them at a small sum per head, and the European rabbit has become a much worse plague on the same island continent.

Intentional introductions of wild species, however, have almost without exception resulted disastrously.

At various intervals between 1850 and 1867 a few pairs of English sparrows were introduced into our Northeastern States to destroy canker worms, and today this species is a ubiquitous and unmitigated pest throughout all the austral and transition regions of North America, finding its limit only at the borders of the boreal zone, while the place of the injurious insect it was imported to destroy has been taken by another and worse insect pest which it will not touch.

In 1872 Mr. W. Bancroft Espeut imported four pairs of the Indian mongoos from Calcutta into Jamaica for the purpose of destroying the "cane-piece rat." Ten years later it was estimated that the saving to the colony through the work of this animal amounted to £100,000 annually. Then came a sudden change in the aspect of affairs. It was found that the mongoos destroyed all ground-nesting birds, and that the poultry as well as the insectivorous reptiles and batrachians of the island were being exterminated by it. Injurious insects increased in consequence a thousandfold; the temporary benefits of the introduction were speedily wiped away, and the mongoos became a pest. Domestic animals, including young pigs, kids, lambs, newly dropped calves, puppies and kittens were destroyed by it, while it also ate ripe bananas, pineapples, young corn, avocado pears, sweet potatoes, cocoas, yams, pease, sugar cane, meat and salt provisions and fish. Now, we are told, Nature has made another effort to restore the balance. With the increase of insects due to the destruction by the mongooses of their destroyers has come an increase of ticks, which are destroying the mongoos, and all Jamaicans rejoice.

The flying foxes of Australia (Pteropus sp.) are animals which are very destructive to fruit in their native home. Frequently some well-meaning but misguided person will arrive on a steamer at San Francisco with one or more of those creatures as pets. While it is not probable that any of the flying foxes will thrive in northern California or in fact in austral regions, the experience is too dangerous to try, and the quarantine officer of the California State Board of Horticulture has always destroyed such assisted immigrants without mercy.

Less than thirty years ago (in 1868 or 1869) Prof. Trouvelot imported the eggs of the gypsy moth (Porthetria dispar) into Massachusetts. The insect escaped from confinement, increased in numbers, slowly at first, more rapidly afterward, until in 1889 it attracted more than local attention, with the result that in 1890 the State began remedial work. This work has steadily progressed since that time and the State has already expended something over a half million of dollars in the effort to exterminate the insect, and it is estimated that one million five hundred and seventy-five thousand dollars more must be used before extermination can be effected.

Contrast with this a single intentional importation which has had beneficial results. The Australian ladybird (Vedalia cardinalis) was introduced into California in 1889, with the result of saving the whole citrus growing industry of the State from approaching extinction through the ravages of the cottony-cushion scale (Icerya purchasi). Later importations of the same insect into South Africa and Egypt also resulted beneficially.

We have thus had sufficient experience with intentional importations to enable us to conclude that, while they may often be beneficial in a high degree, they form a very dangerous class of experiments, and should never be undertaken without the fullest understanding of the life history and habits of the species. Even then there may be danger, as with a new environment habits frequently change in a marked degree.

b. Accidental Introductions.—The agency of man, however, has been more potent in extending the range of species, and in changing the character of the faunas and floras of the regions which he inhabits by means of accidental importation.

The era of accidental importations began with the beginning of commerce and has grown with the growth of commerce. The vast extensions of international trade of recent years, every improvement in rapidity of travel and in safety of carriage of goods of all kinds, have increased the opportunities of accidental introductions, until at the present time there is hardly a civilized country which has not, firmly established and flourishing within its territory, hundreds of species of animals and plants of foreign origin, the time and means of introduction of many of which cannot be exactly traced, while of others even the original home cannot be ascertained, so widespread has their distribution become.

Those accidental importations would at first glance seem to have been more abundant with plants than with animals, since the opportunities for the carriage of seed, especially flying or burrlike seed, and especially when we consider the vitality of this form of the plant organism, are plainly manifold, but I shall later show that possibly even this obvious generalization must be modified in view of the multitudinous chances for free travel which the smaller insects have under our modern systems of transportation.

The agencies which have mainly been instrumental in the accidental distribution of plants are:

1. Wind Storms.—It is obvious that light flying seeds may be carried many hundreds of miles by hurricanes, and may fall in new regions.

2. Water.—This is a very important agency in the distribution of plants upon the same continent, but less important as affecting intracontinental distribution. Still they may be carried by this means from one island to another adjoining island, and when lodged in the crevices of the driftwood, they undoubtedly travel greater distances.

3. Birds.—Seeds are frequently carried great distances by birds. Many of the larger seeds will germinate after passing through the alimentary canal of a bird, and may thus be eaten at one point and voided with the excrement at a widely distant point. It has been shown, for example, that the local distribution of Rhus toxicodendron is greatly affected by the carriage and distribution of the seed in this way by the common crow. Smaller seeds are carried in earth on the feet of birds. Darwin's example of a wounded red-legged partridge which had adhering to its leg a ball of earth weighing 6½ ounces, from which he raised 32 plants of about 5 distinct species, is an evidence of the possibilities of this agency, while his experiment with 6¾ ounces of mud from the edge of a pond which produced 537 distinct plants, an average of a seed for every 6 grains of mud, is still more conclusive.

4. Ballast.—This is the first of the distribution methods which may be combined under the head of "agency of man." The discharge of earth ballast by vessels coming from abroad has been a notable means of distribution of plants by seed. We have just seen how many seed may germinate from a very small lump of earth, and the possibilities in this direction of the many thousands of pounds of discharged ballast are very great. In fact, the ballast grounds in the neighborhood of great cities are invariably favorite botanical collecting spots; they have usually a distinctive flora of their own, and from these centers many introduced plants spread into the surrounding country.

5. Impure Seed.—The great industry in the sale of seed which has grown up of late years is responsible for the spread of many plant species, principally, it must be said, undesirable species. Mr. L. H. Dewey says: "It may be safely asserted that more of our foreign weeds have come to us through impure field and garden seeds than by all other means combined."

6. The Packing Material of Merchandise.—The hay or straw used in packing crockery, glassware or other fragile merchandise is a frequent carrier of foreign seeds. Such goods frequently reach the retailer without repacking, and the hay or straw is thrown out upon the fields or used as bedding for domestic animals and carried out with the manure.

7. Nursery Stock.—Plants are often accidentally introduced by means of seeds, bulbs and root stocks attached to nursery stock or among the pellets of earth about the roots of nursery stock. The extraordinary development, of late years, of commerce in nursery stock has undoubtedly been responsible for the intracontinental carriage of many species of plants in this way.

Instances of the accidental spread of larger animals by man's agency are necessarily wanting. Of the smaller mammals the house rat and the house mouse have been accidentally carried in vessels to all parts of the world and have escaped and established themselves, the former practically everywhere except in boreal regions, or only in its southern borders, and the latter even as far north as the Pribyloff Islands, as I am informed by Dr. Merriam. Small reptiles and batrachians are often accidentally carried by commerce from one country to another, but although there are probably instances of establishment of such species, none are known to me at the time of writing.

Land shells are often transported accidentally across the ocean in any one of the many ways in which the accidental transportation of plants and insects may be brought about, and by virtue of their remarkable power of lying dormant for many months are able to survive the longest journeys. The conditions which govern the establishment of species in this group, however, seem somewhat restrictive; whence it follows that comparatively few forms have become widespread through man's agency, although Binney mentions a number of European species which have been brought by commerce into the United States and have established themselves here, mainly in the vicinity of the seaport towns of the Atlantic coast.

With the earthworms a striking situation exists. It has been shown that, "without a single exception, the Lumbricidæ from extra-European regions are identical with those of Europe; there is not a variety known which is characteristic of a foreign country."* Careful consideration of the evidence seems to show that this is due to accidental transportation by the agency of man.

Comparatively little has been done in the study of the geographical distribution of insects. In the words of Wallace:

"The families and genera of insects are so immensely numerous, probably exceeding fiftyfold those of all other land animals, that for this cause alone it would be impossible to enter fully into their distribution. It is also quite unnecessary, because many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject, while others are so obscure and uninteresting that they have been very partially collected and studied, and are for this reason equally ineligible."

Nevertheless, the time has already arrived with some groups, and is not far distant even with the others which Mr. Wallace has termed "obscure and uninteresting," when, owing to the indefatigable industry of entomologists as a class, important facts can be gained along distribution lines from the group of insects. Thus it is only within the past few months that the publication of Mr. W. F. Kirby's "Catalogue of the Odonata of the World" has made it possible for Mr. G. H. Carpenter, of the Royal Dublin Society, to prepare a comprehensive paper on the geographical distribution of the dragon flies, a group in which a comparatively few workers have interested themselves. It is in a measure true to-day, as it was entirely true when Wallace wrote, that "many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject," yet even with the group in which the greatest obscurity as to the original home of the species has existed, owing to a very easy and most frequent commercial transportation—the Coccidæ or scale insects—the continued discovery and characterization of new forms from all parts of the world, and especially of those existing in wild regions, away from the influence of man, are gradually giving us an insight into the probable character of the original coccid faunas of more or less restricted regions.

By reason of the drawbacks mentioned, Wallace considered only "a few of the largest and most conspicuous families which have been so assiduously collected in every part of the globe, and so carefully studied at home as to afford valuable materials for comparison with the vertebrate groups." These groups included 16 families of diurnal Lepidoptera and six of the families of Coleoptera. Even with this restriction among the beetles, however, he must have had some difficulties with the accidental importations, for among the beetles are hundreds of examples of this class of introductions. For example, writing later in his "Island Life," the great naturalist shows that in 1880 the total number of species of beetles known in the Azores amounted to 212, of which 175 were European. Out of these, however, no less than 101 were believed to have been introduced by human agency. Concerning St. Helena he quotes Mr. Wollaston's opinion that 74 of the 203 species have certainly been introduced by the agency of man.

(To be continued.)

* Paper read before the Zoological Section of the American Association for the Advancement of Science, August, 1897. A portrait of Doctor Howard will be found in the SCIENTIFIC AMERICAN of even date, page 195.

* F. E. Beddard, Text Book of Zoogeography, Cambridge, 1895, p. 154.

Preserving Rubber.—The tendency of becoming brittle which India rubber shows may to some extent be modified by immersing the article in question in a 3 per cent. solution of carbolic acid. Tubing, stoppers, etc., will stand several years' wear without much damage if this precaution is observed.—Der Stein der Weisen.

ENGINEERING NOTES.

Messrs. Burmeister & Wain, of Copenhagen, have recently built in their yard an ice breaker, which has broken all records by cutting through ice 22 ft. thick, extending over a mile, says Engineering. The Nadeshuy, as she is called, belongs to the Russian government, and will be stationed at Vladivostock. Her length is 180 ft., beam 43 ft., her displacement equals 1,500 tons when 18 ft. in the water aft and 13 ft. forward. With engines indicating 3,600 horse power, a speed of 14¾ knots was attained on her trials. The Nadeshuy's frames are closely placed and of extra heavy section, the plating being ¾ in., ⅞ in. and 1 in. steel, with considerable tumble home of both sides and ends. Water tanks fore and aft allow considerable alteration of the trim, and by this means the stem can be brought up so as to draw only 9 ft., while the stern can be put down to 22 ft.

Radhanpur is a small native state in North Gujarat, and is at present governed by a British administrator, the nawab being a minor. The state authorities are anxious that their capital may be connected with the outer world by a railway, and are willing to pay for such length of it as will lie in their own territory. It is expected, says Indian Engineering, that surveys will be carried out early next season, with a view to ascertain to what point on the existing railway systems the proposed line from Radhanpur shall be carried. The points so far suggested are Viramgam, on the Bombay, Baroda, and Central Indian Railway's Wadhwar branch, Patan on the Patan branch of his highness the Gaekwar's Mehsana Railway, and Deesa on the Palanpur-Deesa Railway. It is expected that the necessary surveys will be carried out by the Bombay, Baroda and Central India Railway Company.

The newly constructed ironclad Petropavlovsk will be a valuable addition to the Russian navy, and will prove to be the most powerful vessel in the Baltic fleet. The body of the ironclad has been built in St. Petersburg, on Galerny Island. The armor plates are nickel steel, 10 in. thick, and were prepared in the Ijora Works. Larch wood has been principally used in the construction of the vessel, but her deck is partly of fir and partly of teak. The entire ship's length, including the ram, is 375 ft., the maximum breadth is 70 ft., and the mean draught 25½ ft., and her displacement amounts to 10,960 tons. She is twin screwed, with triple expansion engines of 10,600 indicated horse power, built in England by the firm of Hawthorne, Leslie, & Company. It is calculated that the ship will have a speed of 17 knots. Her armament will consist of four 12 in. heavy guns and twelve 6 in. breechloaders. Besides these, she will carry some Hotchkiss quick-firing guns. Four torpedo tubes have already been mounted. Since her stern draught will not permit of her heavy guns being mounted in St. Petersburg, on account of the shallowness of the Neva and the canal, she will shortly proceed to Cronstadt to complete her armament there. It is hoped that the Petropavlovsk will be ready to undergo her trials at the end of September or the beginning of October.

The Aeronautical Journal for July contains among other features an article on "Flight and Flying Machines," by Major Fullerton, R.E., from which we have taken the following: "There are really only two kinds of flight, viz., soaring flight and driving flight, and it is desirable to consider them separately. In soaring flight the only forces acting on the body are its weight and the air; no artificial force acts on it; and flight of this class is based solely upon skillfully combining the weight and air forces. As a consequence, no artificial force whatever, or, in other words, no power, is required for soaring flight, and provided the wind—or air force—is suitable, and proper arrangements are made for combining it with the force of the weight, there is nothing to prevent this class of flight being carried on indefinitely without any artificial aid whatever. In driving flight the conditions are different. Here two forces have to be developed, viz., the sustaining and the driving force. The most suitable way of doing this seems to be to use either a large sustaining surface, as done by Maxim, or to construct the machine on the lines of Phillips, and use a large number of small surfaces, something like the slats of a Venetian blind. Then, in order to sustain the body in a horizontal path, and drive it along with constant velocity—Sustaining force (vertical component of the air force) = weight = W, driving force = horizontal component of the air force = R, and the power required to drive and sustain the body at constant velocity $V = \frac{R\,V}{550}$ H. P., using the ordinary units of measurement."

The first successful apparatus of which we have any knowledge that burned fuel without the production of smoke was invented by Abu Musa Dschabir Ben Haiyan—better known by the name of Geber—an Arabian alchemist, who lived about the end of the eighth century. He is credited with the discovery of nitric and sulphuric acids, and of certain preparations of mercurial and other metallic salts. Geber called his furnace the Tower of Athanor, and from its construction a steady and uniform heat could be maintained for an indefinite period. Its principal feature, according to Mr. W. F. Durfee, in the Journal of the Franklin Institute, was a high cylindrical tower for containing the fuel. This tower was flanked by two combustion chambers, in or over which the substance or vessel to be heated was placed. These chambers were connected with the central tower near its base by flues, in which were dampers for regulating the flow of the gas generated from the fuel. This furnace of Geber was in fact a "gas furnace," and the general principles involved in its construction were the same as we see in everyday use in all self-feeding base burning stoves, and in many gas furnaces for metallurgical purposes; in fact, many of the so-called improved gas producers are no better and but slightly different from that invented by Geber over 1,000 years ago, and he must be regarded as the discoverer of the great advantages resulting from converting solid fuel into a combustible gas, and then burning that gas in a combustion chamber separate from that containing the solid fuel. Geber's furnace was not a mere suggestion, but was in common use by chemists in all well-appointed laboratories until the beginning of the present century.

ELECTRICAL NOTES.

A railway is to be exhibited at Paris (France) in 1900 which differs from the present style of railways in this respect, that the cars do not move on the rails, but the rails themselves are moved over fixed wheels. The wheels are driven by electricity. A stop must be made for each passenger who wishes to get in or out. The railway will probably be constructed as an elevated road.—Zeitschrift für Architectur.

Electric motor cars are to replace steam locomotives on the Chicago & South Side Elevated Railroad, and when this change is made all the elevated railways in Chicago will be operated by electricity. Work has been commenced laying the third rail under the direction of Mr. E. Klapp, chief engineer, and it is expected that the third rail and feeder cables will all be laid on the structure by the end of November. In the Sprague system of electric traction, which has been adopted, each car will have its own motors, all the cars of a train having electrical couplings, so that the entire train is operated from the front car. On all the other elevated lines the front car only is fitted with motors, and is thus an electric locomotive, the other cars not being equipped with power.

The electric tramways in Dresden are equipped with Siemens & Halske's electric brakes. These brakes act upon the car axle, which is not driven by the electric motor. They are fixed both upon the motor car and upon each of the trailers, and act simultaneously. It is claimed that these brakes act in about one-third of the time of the hand brakes. Trials with both show that the electric brake stopped a car going at a speed of fifteen miles per hour within fourteen yards, while a car with a hand brake going at twelve miles per hour traveled thirty-five yards after the brake was applied. The same electric brakes are used for the line Behrenstrasse-Treptow, at Berlin, says the Electrical Engineer. In this case the brake acts upon the motor direct, and there is no brake upon the trailing carriages. When going at the usual speed these cars are stopped within eight yards.

Although there are several plans to the fore in Sweden about important electrochemical manufactories, to which the abundant water power lends itself admirably, says London Engineering, there are not yet many in operation, the most important being the one for manufacture of chlorate of calcium at Mansbo, where the process used is the one patented by Mr. O. Karlson. The Mansbo waterfall represents the aggregate power of about 5,000 horse power, of which, to begin with, only a small portion was utilized. There were 8 turbines of 220 horse power each, revolving at a speed of 260 revolutions per minute; they have horizontal axes and are directly coupled with their dynamos. The normal capacity of the latter is 1,200 amperes, 115 volts, and they are being worked both day and night. The machines work independently of each other. The current is conveyed from the dynamos to the electrodes, of which the one is of carbon, the other of iron. The original output was fixed at 690 tons per annum, but this has been found altogether inadequate. The installation has, therefore, been extended very materially, and now represents 3,000 horse power and an annual output of some 1,300 tons. The whole installation has cost rather more than $400,000, the cost of machinery and plant being about equal to that of the necessary constructions which were required in order to utilize the water power.

An electric tramway installation is being laid down in Brisbane under the supervision of Mr. J. S. Badger on behalf of the General Electric Company of America. According to the Electrician, the track is laid on sleepers and is chiefly double, the rails weighing from 55 pounds to 83 pounds per yard and bonded with the Chicago bond. The total mileage is about 25½ miles of single track, the furthest point being distant 5,683 yards from the power station. The overhead trolley system is being employed, with side poles and span wires. No. O. B. and S. copper wire is employed for the trolley wire and the majority of the poles are of iron. The feeders are run overhead and are 500,000 circular mils. The boilers are of the Babcock-Wilcox type, and work at 170 pounds steam pressure. The engines are Robey's horizontal compound condensing, with trip gear. The engines have cylinders 17⅝ in. and 30⅝ in. by 40 in. stroke, and are designed for a most economical load of 450 indicated horse power, with 150 pounds steam at the stop valve. They are coupled by leather belting 36 in. wide and 30 ft. centers to General Electric multipolar generators. These generators are of the four-pole type, over-compounded from 500 volts at no load to 550 volts at full load (550 amperes). The cars are propelled by two motors of the General Electric type—25 electrical horse power each—which are fitted to the car with a nose suspension. The cars are fitted with ordinary hand brakes and series parallel controllers.

A very clever mail delivery box has been placed in a number of the larger buildings at Geneva, Switzerland, by an enterprising electrician. This mail box has a compartment for each of the stories of the building, and when the letters are deposited on the ground floor, the carrier delivers them as required. The deposit of a single letter makes an electric contact, which starts a bell going on the respective floor, which does not cease ringing until the letter is taken out. At the same time it opens the faucet of a tank on the roof of the house, which causes water to flow into the cylinder forming the counterweight of the mail box elevator until the weight is heavier than the box, when the box ascends and the flow of water ceases simultaneously. As the box passes each story the mail intended for it—letters, papers and small packages—falls into boxes in the corridor on that floor. This is performed very reliably by a little spring at the bottom of each compartment in the elevator mail box, which causes the bottom of the compartment to catch for a moment, and the release throws out even a single piece of paper thinner than a postal card into the stationary box provided for its reception. When the box has passed the uppermost floor the cylinder filled with water strikes a bolt provided at the bottom, which allows the water to flow out, and by its own weight the box descends to its place on the ground floor. Should by any mischance a single piece of paper have remained in the elevator, upon striking the bottom it will at once go through the same series of movements as before.

MISCELLANEOUS NOTES.

Berlin, the German capital, had its first sidewalk in 1827, on the "Breite Strasse." A private individual put it down before his house, and was honorably commended for his conduct by the king.—Monatschrift für den Oeffentlichen Baudienst.

Siemens & Halske propose to treat gold-bearing stibnite by dry chlorination, lixiviation with water drying and again subjecting to the action of chlorine gas. After a second lixiviation, the gold is supposed to be mostly in solution. The residue is then treated with HCl, whereby the antimony is converted to chloride, which is dissolved, and the solution electrolyzed, metallic antimony and chlorine gas being produced. The gold is precipitated from the first solutions by electrolysis, or any practicable method.

The Northwestern Lumberman says that a new industry has arisen in Michigan, namely, the conversion of pine stumps into shingles. It is stated that stumps of trees which were cut twenty to twenty-five years ago remain enduring and obdurate obstructions to the cultivation of the soil. They are still sound and turn out excellent shingles when so utilized. This shows the lasting quality of white pine. In the early days of lumbering in Michigan the tree was cut high from the ground, and these old stumps which the farmers are cutting into bolts represent the method of that period. In later years, economy in a material which had become too valuable to waste dictated the cutting of stumpage as near the ground as possible.

The value of foreign books imported into Germany has risen from $2,000,000 to $5,000,000 in the thirteen years from 1883 to 1896. The figures for 1896 are as follows:

Austria-Hungary	$1,800,000
Switzerland	800,000
France	700,000
Holland	400,000
England	400,000
Russia	180,000
United States	178,000
Various other countries	560,000

If we except Austria-Hungary and Switzerland, which publish many works in German, we find that France stands first in the list.—La Vie Scientifique.

How is it that the British exports of Portland cement to the United States have dwindled so much during the last twelve months? For the year ending 1896, the imports in the United States from England amounted to 297,000,000 lb., while for the year ending May, 1897, they were only 174,000,000 lb. In these two periods the imports from Belgium remained nearly stationary, falling only 3,000,000 in a total of 237,000,000, while Germany's contribution has fallen only 73,000,000 in a total of 482,000,000. In other words, while Belgium's trade has diminished less than 2 per cent. and Germany's only 15 per cent., our trade has been reduced nearly 42 per cent., says The Builder. If this reduction is due to increased activity in the building and engineering trades at home, there is no cause for complaint; but if it is due to the better quality and cheaper prices of foreign cement, it is high time that British manufacturers made an effort to regain the lost ground.

The invention of frieze is claimed by a historian of the Netherlands to have been made by the inhabitants of that country, says the Trades Journal Review. They were famous for their à friser or napped cloth. It is possible that the name of the material may have come from its having first been made in Friesland. Later the name was applied to linen, for in 1641 we find, says Fiber and Fabric, linen of frieze mentioned, and in 1671 under the head of linen, "frieze cloth." It appears to have been very early an Irish product. In 1399 "frieze of Coventry" is mentioned. In the sixteenth century this cloth came to be more generally adopted. It is spoken of by one author as a coarse kind of cloth manufactured in Wales, "than which none warmer in winter, and the finest sort thereof very fashionable and genteel. Prince Henry had a frieze suit made." An act of 1551 refers to frieze as a Welsh manufacture, and mentions counties which were specially noted for its making. At that time it was made in finer qualities than we usually associate with the material, and men of the highest rank had clothing made of it.

At a recent meeting of the Société de Statistique, Yves Guyot made the following interesting statements concerning industry and commerce in France, says The Engineer. Of French exports, 90 per cent. fall to foreign countries, 10 per cent. to the Colonies. The value of the French home trade amounted to 7,200,000,000 francs in 1896, or 187 francs per head of population, which is about the same as in Germany. The value of the English imports to France amounts to 510,000,000 francs, and the value of exports from France to England 1,030,000,000 francs. Belgian imports to France, 282,000,000 francs; ditto exports, 501,000,000 francs; German imports, 307,000,000 francs; ditto exports, 339,000,000 francs; United States imports, 1,313,000,000 francs; ditto exports, 224,000,000 francs. These four countries consume 61 per cent. of the total French exports, while England alone consumes no less than 30 per cent. On the whole, 7,274,500 tons, worth 3,401,000,000 francs, have been exported, and 22,619,000 tons, worth 3,799,000,000 francs, have been imported to France.

The New York Prison Association will hold an exhibition of articles made by convicts and of prison appliances in its rooms at 135 East Fifteenth Street on October 7, 8 and 9. The exhibition will be divided into groups. In the historical section will be shown pictures and plans of prisons, relics of famous jails and of criminals and crimes. The gallery of portraits of prison keepers and reformers will form part of this section. In another group will be shown models of cells, apparatus used in punishments and executions, police appliances, and forms and blanks showing the organization of prisons. The other sections will be made up of drawings and charts representing criminal types and peculiarities, publications on penology, instruments used in making identifications, literary and artistic work of convicts, and articles made by prisoners. There will be a series of conferences between prison workers while the exhibition is open. Dr. H. E. Allen, the superintendent of the asylum for the criminal insane at Matteawan, will read a paper on insane criminals.

PREVENTING MILK TURNING SOUR.

As soon as the true causes of milk and cream becoming sour or otherwise deteriorating in flavor became known, scientists set to work to discover some means of destroying the bacteria without at the same time injuring the milk. Chemicals of various kinds were tried, but there are objections to the use of all of them. The most successful of all methods of preserving milk and cream yet discovered are those known as pasteurizing and sterilizing. The latter of these is necessary only when milk and cream have to be kept sweet for weeks and months. The two operations, though alike in principle, yet differ in degree. In both, heat is applied to the milk or cream, but not to the same extent. In pasteurization it is necessary to raise the temperature to between 150 to 175 degrees F., and keep it there for about twenty minutes to destroy all active bacteria present. In sterilizing, the temperature must reach or exceed 212 degrees F., that is boiling point. The objection to sterilizing is that it gives a burnt flavor to the product. The pasteurizing process, if properly conducted, leaves no perceptible difference in the taste. As both processes accomplish the object of keeping milk perfectly sweet for a longer period than it would otherwise do, it is clear that for dairying operations pasteurization is preferable to sterilization. The great advantages of treating all cream for butter making by pasteurizing it does not, it is stated by Mr. S. Lowe, seem to be fully recognized in the colonies. In Denmark and Sweden more than 90 per cent. of the butter exported is made from pasteurized cream. During the very hot weather in the Australasian colonies the necessity for this process is most imperative. Artificial refrigeration cannot repair the injury already done to milk or cream by the growth of bacterial life; it can only prevent further injury. If the evening's milk has not been rapidly cooled and kept so during the night, it swarms with bacteria when brought to the factory in the morning, many of them being of the baneful variety, and the cream should be carefully pasteurized; that is, the bacteria should not only be prevented from further increase—they should be killed right off. If the factory manager allows even one farmer's cream which is swarming with evil bacteria to mix with the sweet cream of the rest of his supplies, he will soon discover that the proverb of "Ill weeds grow apace" is as applicable to the cream vat as to the garden.

Let us now explain how pasteurization keeps milk sweet for a much longer time than it would otherwise do. The minimum multiplying point of most milk bacteria may be taken at 50 degrees F., the maximum at 113 degrees F. Between these points they multiply in various degrees of rapidity. Thus, while bacteria can live from below zero to about 150 degrees F., they can only multiply from 50 degrees to about 113 degrees F., the temperature most suitable for their growth being 80 degrees F. to 100 degrees F. From this it follows that, if milk be kept below 50 degrees or above 113 degrees, the bacteria in it cannot multiply, though those already existing can at these temperatures carry on their processes of converting the sugar of milk into various acids. Hence, if milk be already swarming with bacteria, it is best to raise the temperature to such a point as will kill them right off, and this temperature, we have seen, is 150 degrees and upward. We have given the pasteurizing temperature as 150 degrees to 175 degrees F. Above this there is danger of producing the burnt flavor previously mentioned. At 150 degrees it takes longer to kill the bacteria than at 175 degrees. At 155 degrees twenty minutes will do, at 160 degrees fifteen minutes, at 165 degrees ten minutes, and so on. Pasteurizing, however, does not kill all bacterial forms. It destroys those that propagate by fission only. It does not kill those that multiply by spores. The baneful kinds, unfortunately, are those which mainly breed by spore formation, and hence are more difficult to kill. In fact, only a sterilizing temperature is sufficient for this purpose. Herein lies a great danger. Unless pasteurized milk is rapidly cooled down to a temperature at which these spores become torpid, pasteurizing is very dangerous, for there is every probability that all the beneficial bacteria will have been killed and only the baneful ones remain alive. Therefore, artificial cooling process must be used along with pasteurization if the best results are to be obtained.—Gardeners' Magazine.

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